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ELECTRICITY IN SIBERIA.

Few people have any knowledge of commercial opportunities in Siberia. This is a most important country, and has not begun to be worked for American electrical trade. We understand that there is not a gasworks in the breadth of the land. What a chance for the incandescent lamp. Siberia is a cold place (generally), but there is a summer time there when it is "hotter." A recent traveler has failed to find a solitary electric fan, even where there was power to run one.

ELECTRICAL DISPERSION OF FOGS.

At a recent meeting of the British Physical Society, Sir Oliver Lodge described his work upon the dispersion of fogs and dust clouds by means of electrical discharges into the atmosphere. It has been known for many years that, when a body surrounded by a cloud of dust or mist is electrified, that portion of the cloud immediately around the body is dispersed, the particles cohere, and either sink to the ground or are driven away. In the case of mist a fine rain is formed. Sir Oliver suggested, some years ago, that this effect might be put to practical use to disperse fogs, and he has endeavored to interest a number of bodies in this matter and have it put to test, but so far without success.

Successful Experiments.

Sir Oliver has, however, tried at Liverpool to disperse fogs, using for this purpose a Wimshurst influence machine which discharged by means of a bundle of points into the air. A very high potential is necessary, and to increase the surface a large gas flame was used to supplement the points. On one occasion the discharge of electricity from the flame was sufficient to keep a clear space of fifty or sixty yards radius in a dense fog. Although these experiments were promising, the Wimshurst machine did not seem suitable for every-day use, and there was no other generator which would give a sufficiently high direct voltage to do the work.

Method of Obtaining High Voltage.

To overcome this difficulty, Sir Oliver now uses the rectifying properties of the Cooper Hewitt mercury vapor lamp. To procure the necessary high potential, current from a high-frequency dynamo is carried through an induction coil and then connected to the terminals of the rectifier. The rectifier consists of twelve lamps connected in a quadrilateral having three lamps in each arm, and rectifies both sections of the alternating-current wave. This arrangement gave him unidirectional sparks two or three inches long, and was very effective in laboratory experiments.

Difficulty in the General Application.

To dispel the fog in a circle of fifty or sixty yards' radius is a noteworthy performance, but the general application of this method seems to be rather far off. The cleared area will have to be extended much more than sixty yards from the discharge station before the system can be of use in harbors or at sea, thus necessitating the use of very high voltages, such as are at present impracticable. There are, however, waterways—such as the Manchester canal or the Chicago river, in which the channel is narrow and the traffic very great—where a system of dispelling fogs only slightly better than this would be very useful. It is to be hoped that Sir Oliver will carry on his work and will be able to report much more successful experiments before long.

THE VALUE OF TECHNICAL EDUCATION.

If any more evidence were needed to prove that the value of technical education is now well recognized, the address delivered before the American Society of Mechanical Engineers, by President James M. Dodge, would probably be conclusive. However, the growing demand for technical men, and the crowded courses at the technical schools, are alone sufficient to prove the case. It is true that there has been a great deal of discussion and even criticism of our technical courses as now laid out, but these criticisms merely indicate that there is a growing demand for men with a broader training and a wider view than that given by our present somewhat narrow engineering courses. The rapid growth of the electrical industries created a great demand for men with a special training, and it was to meet this demand that these courses were laid out. Now the employers have tested technical graduates, and they appreciate their value; but there is a new demand for men whose training has been carried further than that which can be given a college student in four years. To meet this new demand, several technical institutions are now offering graduate courses in engineering subjects.

The Money Value of the Man.

Mr. Dodge in his address takes up only the money value of technical training. He compares the earnings of young men of four classes—labor, shop-trained or apprentices, trade school and the technical school—from the time they are sixteen until they have reached the age of thirty-two. Comparison is made by capitalizing at five per cent the young man's earnings for fifty weeks, the figure thus obtained being designated as his potential value. A chart thus constructed shows that the laborer starts with $3 a week when he is sixteen, and rises to $10.20 by the time he is twenty-one; but he rises no higher. His potential value at that wage is $10,200. The apprentice or shop-trained worker starts with the same wages as the laborer at sixteen, but rises more rapidly, and is earning by the time he is twenty-four years old, $15.80. His potential value at that time is $15,800, but he makes no further rise. The trade school graduate, starting at the same point, rises still more rapidly, and is earning when he is twenty-five years of age $22 per week, his potential value at that time being $22,000. From this point his wages rise less rapidly, reaching possibly $25 a week at the age of thirty-two, and representing a potential value of $25,000.

Value of the Technical Man.

The graduate of the technical school starts at the same point at a weekly salary of $3, and is earning $4 when he enters college at eighteen. Upon graduating from college, at the age of twenty-two, he can draw a salary of $13 per week. He has then already passed the laborer, but is still a little below the shop-trained apprentice. He passes the latter, however, during his first year of employment, but is still below the trade school graduate, whom he does not overtake until his twenty-fifth year. From this point on he rapidly leaves behind the other three workers and at the age of thirty-two is drawing $43 a week, his potential value being $43,000; and the curve indicates that his value is still rising, although at a slower rate. Thus, four years' training at a technical school makes a man, by the time he is thirty-two, four times as valuable as the laborer, approximately three times as valuable as the shop-trained apprentice, and seventy-two per cent more valuable than the trade school graduate. Surely a good return for four years spent in preparation.

Other Considerations Have Influence.

Mr. Dodge's method of analysis should carry conviction to certain classes of employers. On the other hand, it does not take into consideration other phases of this problem which doubtless influence many ambitious young men. It is certainly some satisfaction to such a man to occupy a more important position than his brother workers, and to feel that he is an important factor in the development of his profession, and in the advancement of the world.

REPORT ON THE EDISON STORAGE BATTERY.

On another page of this issue is given an abstract of a paper presented at a recent meeting of the British Institution of Electrical Engineers by Mr. W. Hibbert, and which gives the results of tests made by the author on the Edison standard automobile cell. The report will, doubtless, be read with interest, as there has been a demand for information concerning this battery based upon actual results. These tests were carried out during a period of six months, and the endeavor was made to determine as far as possible in this time, the actual value of this cell. The method of conducting this test was to determine the efficiency of the cells at different rates of charge and discharge in the laboratory, and then to see whether they would give the same efficiency under running conditions, and to determine what deterioration took place.

Laboratory Tests.

The tests show that the efficiency of the cell in the laboratory is somewhat less than that of the lead cell, but, under garage conditions, it is possible that the lead cell would not make as good a showing as it does in the laboratory, while the Edison cell seems to be less affected by unfavorable conditions. Tests made to determine the effect of ill usage showed that conditions such as short-circuiting or allowing the cell to stand while charged, caused no injury by the first treatment, and that the loss in efficiency during the second was not great.

Running Tests.

To test the cell under actual operating conditions, a car equipped with an Edison battery was secured, and this was run under conditions as varied as possible. From these tests Mr. Hibbert comes to the conclusion that the cell gives practically the same efficiency when in actual use as it does in the laboratory; and at the end of his test he was not able to detect any deterioration.

ELECTRICAL ENERGY DIRECT FROM COAL.

On another page of this issue will be found a description of an apparatus which has been devised by Mr. James H. Reid, of Newark, N. J., for the purpose of producing electrical energy direct from fuel. The elements of the apparatus are an iron containing-vessel, forming one electrode; a fused electrolyte of the oxides of sodium calcium and iron, contained in the iron vessel, and a hollow electrode of porous carbon. Combustible gas of any description, mixed with forty times its volume of air, is forced into the carbon and finds its way out through the pores, coming in contact with the electrolyte, which is kept hot by some external means. The mixture of gas and air, in rising through the electrolyte, keeps it in circulation and brings fresh portions in contact with the gas. The apparatus gives an electromotive force of 0.9 volt per couple on open circuit, and upon short-circuit will deliver heavy currents.

The Inventor's Notion of the Action.

The inventor says that his apparatus can not be compared with any other device heretofore produced. He does not think that the effect is electrochemical, nor is it thermoelectric; but he believes the action is rather to be compared with the breathing of animals, where the action of the lungs continually brings an oxidizing medium in contact with the blood.

The Action Not Electrochemical.

From the demonstration which was made, we are hardly ready to accept this view; nor does the action seem to us to be electrochemical. If the action were electrochemical, the combustible and oxidizing gases should be supplied at opposite ends of the cell, but here they are mixed before being forced into the cell. Further, the analogy offered by Mr. Reid does not seem to us to hold, for the fuel supply for animal life is certainly not taken in through the lungs with the air.

The Jacques Cell.

We, however, think that the action of the cell can be explained as thermoelectric. It will be remembered that when the Jacques cell was brought out some seven or eight years ago, Mr. C. J. Reed proved the action to be thermal. The Jacques cell consisted of an iron vessel containing a fused electrolyte and a carbon rod. Air was forced into the electrolyte below the carbon and rose about it. This had the effect of keeping the contact of carbon and electrolyte cooler than that of the electrolyte and iron. The temperature of the cell was about 400 degrees Fahrenheit. The same electromotive force was produced when the air was replaced by any negative gas. The potential was 0.9 volt, and heavy currents could be drawn off. The apparatus was not found to be an efficient generator of electricity. The electrical energy was not produced by the oxidation of the carbon rod.

Action Probably Thermoelectric.

Now, while there are several marked differences between the Jacques cell and Mr. Reid's apparatus, these do not seem to have any effect upon the result. We have in the Reid apparatus an iron vessel, a molten electrolyte and a carbon rod surrounded by the gases forced through it. The voltage developed is the same as that of the Jacques cell. If there were any other action present, should not the voltage of the cell be greater? because this thermal electromotive force must also be present—that is to say, if a thermo-couple, consisting of iron, a fused electrolyte, such as here used, and carbon, gives at about 400 degrees Fahrenheit an electromotive force of 0.9 volt, any other electromotive force set up by any other cause should either add to or subtract from this, and we would not expect to have an open-circuit voltage of 0.9 volt. This could easily be tested by forcing ordinary air through the carbons, omitting the combustible gas. Should this apparatus prove to be merely a thermoelectric generator, its efficiency will, of course, be limited by the second law of thermodynamics, and the device can hardly be expected to be of much commercial value. It might be remarked that in the demonstration, while the terminal voltage of the two cells in series was 1.8 on open circuit, it fell to about 0.1 volt when short-circuited through an ammeter and delivering about fifty-three amperes. The output of the two cells was then only 5.3 watts.

The Apparatus to Be Tested.

Mr. Reid has, however, made some tests with a cell of similar description, and he says that he obtained an efficiency of transformation of the energy contained in the gas to electrical energy of about seventy-two per cent, making an efficiency from coal to electricity of about forty-five per cent. The efficiency of the gas-producing process was about eighty per cent. He intends to have his apparatus tested by disinterested experts, and should his figures be verified, it is hardly necessary to say that they will demonstrate the success of his apparatus.

MEETING OF THE UNDERWRITERS' ELECTRICAL COMMITTEE.

The electrical committee of the Underwriters' National Electrical Association met in New York, December 2 and 3. The meetings were well attended by electricians connected with the insurance companies, by members of the national conference on electric lighting rules, by members of the code committee of the American Institute of Electrical Engineers, and by officers of the National Electrical Contractors' Association. Any proposed rules or changes were therefore considered from the standpoint of the electrical engineer and contractor, as well as from that of the insurance company. At these meetings there were but few changes proposed, the policy of the committee being to pay less attention to small details, and to lay greater weight on the general principles of the results to be obtained.

Importance of Work of the Committee.

The work of this committee is of much importance to all interested in electrical matters, as it is obviously to the advantage of all concerned that sensible and satisfactory rules be adopted, sensible because they work hardship to none and satisfactory because they protect against unsafe material and work. The membership of the committee is evidently such as to promote confidence in its rulings in all matters.

SOME ELEMENTS INHERENT IN AUTOMATIC TELEPHONY WHICH MAKE IT POPULAR.

BY JOSEPH B. BAKER.

THE SERVICE OF THE AUTOMATIC REGARDED AS A STANDARD.

The accelerated rate of growth in the use of the automatic telephone exchange system, indicating as it does the recent enlightenment of responsible telephone managers and engineers, warrants the prediction that in a few years machine telephone operating will be "the thing," just as common battery systems of manual exchange operating have been the thing ever since the central energy idea gained a firm foothold in the art of telephone communication, because the growth of the traffic had reached a point no longer endurable by the local battery, magneto-ringing systems. This accelerated growth warrants also, in the writer's opinion, the taking of a radical point of view in explaining the merits of the automatic system. The reader is asked to look fairly at an automatic subscriber's station set and the new art of electric communication that it stands for; considering, with the writer, the service given, point by point. The best cause can be put in an unfavorable light by seeking faults in it, by destructive criticism based on false premises; and of these there has been too much in the past in discussions of the merits of the automatic telephone exchange system, even by responsible telephone engineers. The time has quite gone by, in view of the hearty and responsible support given in substantial form by the managers of so many telephone companies recently, for either ignorance or prejudice to stand in the way of proper appreciation of the automatic. Indeed, the time has gone by, in discussions of this subject, for any sort of a defensive attitude to be taken by believers in the automatic. The installations that were put in years ago and have been working ever since with varying success, but always working, have served their purpose of helping to enlighten the public, of creating a widening demand for the new art of telephone communication that they exemplified in such striking contrast with manual systems with which they competed locally. These installations served as "trial horses" in the development of the apparatus under the severe conditions of actual service, whereby the newer plants, whose inauguration of service is now attracting the careful attention of all telephone men, have been able to be equipped with apparatus that is mechanically perfected.

The telephone men in charge of the expenditures for these more recent automatic installations—men who can not afford to try experiments with the money of their stockholders—have clearly seen their best interests in the installing of automatic apparatus, after studying its practical working at Fall River and New Bedford, Mass.

CHARACTER OF THIS NEW STANDARD SERVICE.

What is the character of the service given by an automatic telephone exchange installation? The telephone set, with its numbered dial adapted to calling any number that can be expressed in Arabic numerals by a simple, time-saving method, stands for a telephone service that completely justifies its claim as an instrument in a new art of electric communication. It is a mistake to start with the thought that the automatic is a mere improvement on the manual, a last result of the evolution of the telephone switchboard. It is not an improvement, nor the product of one; it is the embodiment of a revolution begun (and begun right) as a correct idea for accomplishing a desirable end, carried through long and painful stages of laboratory development; tested and refined by the ruthless processes of actual commercial use; and reduced in the fulness of time to mechanical perfection, of an order recognizing the deepest needs of the telephone service, by the application of sufficient capital, inventive talent and skilled organization. The result of all this independent evolution in telephony is, to-day, a system of mechanical operating that works like a machine.

The many years' growth of the use of the telephone have seen many ingenious improvements in manual switchboard and operating systems that were improvements in the struggle to adopt mechanisms to a multiplied pair of hands. But these systems do not and can not give a "telephone service" in the sense that the automatic does. Under the pressure of the growth of the telephone traffic that began as a hand-operated system of communication, these manual systems provided the means and possibility of connecting any subscriber to any other subscriber in large and small communities under conditions of improvement of detail whereby the earliest and smallest exchanges could grow to give the same kind of service to large cities.

COMPARATIVE INEFFICIENCY OF THE MANUAL SYSTEM.

The operation of calling from an automatic set by partial rotation of the dial from the proper numbers, thus sending in the successive numerals of the number to be connected and causing the simultaneous selection of that number or the selection of the "busy" signal sounding in the ear of the party calling, is a simplified group of operations comparing favorably both in method and result with the old system of passing a call. It compares favorably in method, because by the automatic the giving of the order itself constitutes the execution of it, with no probability of error (mechanically speaking, and apart from sheer mistake by the party calling). The group of operations executed by the automatic compares favorably in result (from the point of view of the subscribers, which is and ought to be the traffic criterion) because the automatic presents to the party calling, after a comparatively very short interval and one never raised or extended by pressure of traffic, the actual facts of the state of his call, whether the connection is given him or denied him.

THE AUTOMATIC SERVICE SUPERIOR IN KIND AS WELL AS IN DEGREE.

Passing by several points that invite examination, but that would unduly lengthen this article, consider briefly several features of the modern service given by the automatic that appeal especially to that greater army of telephone operators—the public of telephone users—by their contrast to the old cord-and-plug hand-operated service. The strict privacy of conversation and absolute freedom from either interruption or disconnection is in refreshing contrast to the dangers that lie in wait for a manually operated call. With no operators to listen, no keyboard in which two or more lines may be crossed up, and no party lines with their opportunity for eavesdropping; with no hand-operated connections, precariously defended by a very fallible complexity of signals, the user of the automatic approaches his telephone with a sense of security and privacy that never has obtained, in the very nature of things, with the manual. This is a feature whose full importance can not be realized by any one in advance of an actual experience with the automatic service; that alone can impress upon him all that genuine privacy, security and directness in the use of the telephone means.

The disconnection, instantaneous upon the working of either subscriber's hook,

opens vast possibilities of a quick succession of calls, useful in getting market prices, etc., and is another expression of the ever-present fact that all the time spent at an automatic telephone is live time. The hearing of the "busy signal" by the party calling means that the actual instrument of the party called is in use—not, that it has been in use at some recent time; and automatic telephone users have not been long in learning that it pays well to keep trying to get a line reported busy, since by this they can be sure of getting their party within two or three seconds of the last busy signal. The point often urged by opponents of the automatic, that the public will miss the human operator and will not put up with a machine as a substitute, is little less than absurd as a contention in view of the ample number of precedents to the contrary in American use of labor-saving machinery. But apart from this, it is a fact that in local telephone service the essential functions of the operators are the execution of mechanical movements that command and receive the wages of common labor; the additional and less elementarily mechanical functions having been added to the duties of operators in the continually more difficult struggle to help out the service under its terrible handicap of dependence on manual labor. As for the associated contention that an all-machine organization is liable to get out of order, leaving the subscriber helpless, the basis of pro-manual argument is equally shaky. The duties of the office inspectors in automatic exchanges do not call their attention to the panel and keyboard apparatus or manual switchboards, or to the relay racks connected therewith; their work, apart from care of the power plants, common to all telephone exchanges, consists largely in patroling the automatic switchboards (in which the individual switches, selectors and connectors, are arranged to be thoroughly accessible from all sides without sacrifice of compactness), ready to note and remedy troubles. These men get the usual salary of an office inspector, and by experience with the comparatively simple apparatus proposition of the automatic exchange, are able in most cases of trouble to note its existence and character by variations in the clicking sounds of the switches, and to apply the remedy before the calling subscriber has time to formulate his complaint. In the newer exchanges the switchboards are so grouped as to facilitate the tracing of a call and the prompt location of trouble.

Problems of effective insulation against leakage cross-talk; of firm rubbing contacts in circuit whereby the variation of line resistance measured from telephone to telephone of a pair connected through all the trunks compares favorably with that introduced by the best forms of plug-and-jack contacts of manual boards; of margin of safe operation of switch relays (mounted directly on the switches) for various lengths of subscribers' lines; and other problems that have come up in the course of experience in practical exchange working in competition with the Bell and under varied conditions, have been met and solved upon the high plane of an organization designed to work like a genuine machine.

The beneficiary of the service given by the automatic no longer feels the old sense of a helpless struggle with annoyances beyond his control; but, instead, the sense of being in direct control of a new art of electric communication that joins instantaneous connecting with instantaneous voice transmission to give, at last, a genuinely modern telephone service.

THE MONEY VALUE OF TECHNICAL TRAINING.[1]

BY JAMES M. DODGE.

Technical training may be self-acquired or obtained through instruction. The ability to drive a nail properly, or to design and construct the most complex and wonderful of structures or devices, is the result of technical training in but different degree. Up to a very recent date, and within the memory of most of us, the apprentice system and that of independent delving represented the sole methods of acquiring training. Research and investigation carried on in individual lines, with varying degrees of success, depending upon the mental makeup of the individual, were the means of attaining theoretical technical knowledge. The blending of these two methods developed the earlier mechanical engineers and will, even in the future, enable those sufficiently gifted by nature and habit to attain eminence. The progress of the world, however, calls for a better and more speedy means of producing trained men than could ever be developed by the methods of self-instruction. The individual, striving for manual skill, attains his desire under the old apprentice system. Individuals sufficiently gifted rise above their fellows, and become the leaders in their calling. The gratification of a mechanical appetite and the desire to earn more money than his fellows are two moving causes which impel a man toward technical education. A generation ago, the universal belief was that the sooner a young man entered upon his apprenticeship, or began practical manual work, the better and more rapid would be his progress in the mechanic arts, and book learning was derided as being purely theoretical, and of little practical value. This belief is, even at this date, all too prevalent, largely due to inherited error, and to lack of knowledge and reliable data.

Obtaining data from which incontrovertible conclusions can be drawn is now comparatively easy, but a few years ago was practically impossible. We are all prone to take extreme cases of success or failure as the basis of our opinions, and lose sight of the fact that it is the average man whose career shows the true force and direction of the current. For convenience of comparison, I will outline the actual progress made by four groups of men working in the mechanic arts—the unskilled labor group, the shop-trained or apprentice group, the trade school group, the technical school group, and give the results obtained. Each group I will refer to as an individual.

The first, the laborer, with but primitive and rudimentary training, working under the immediate and constant supervision of a boss, and earning, as the line on the chart indicates, $10.20 per week at the age of twenty-two, his line remaining horizontal through the period of his usefulness. Data are lacking as to his progress before he reaches the age of twenty-two.

The second, the apprentice or representative of the shop-trained group, of good health and habits, entering a machine shop at the age of sixteen, and earning an average wage of $3 per week for fifty weeks per year, which is about the number actually worked, is $150, or five per cent on $3,000. This, then is his potential or invested value, upon which he draws his interest on paydays.

We now note that his accumulated experience enables him to make more rapid progress, and from the age of twenty to twenty-one and one-half years we find that his pay has increased to $13.20 per week, and his potential value to $13,200. He is now approaching his goal, and his line of progress does not continue at the same angle that it followed for the past few years, but deflects toward the horizontal; and at the age of twenty-four we find him earning $15.80 per week, and his potential value $15,800. In other words, in

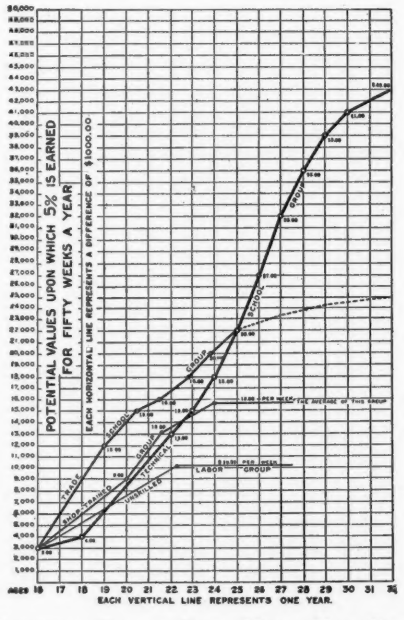
[1] Abstract of president's address at the New York meeting December, 1903, of the American Society of Mechanical Engineers.

eight years he has increased his potential value $12,800. Observation shows that five per cent of the apprentices acquiring the machinist trade rise above the line made by our average man; thirty-five per cent follow the line closely, and that during the period of training twenty per cent leave of their own accord, and as near as can be ascertained, go to other shops and continue in the line originally selected; forty per cent, however, are found unworthy or incompetent, and are dismissed, probably never rising to the $15.80 line.

The third group of young men are those fortunate enough to have had the opportunity of entering a trade school, which they do at sixteen years of age, devoting the next three years of their lives, or until they are nineteen years of age, acquiring a trade under competent instruction, and at the same time adding to their store of rudimentary theoretical education. At the age of nineteen a trades' school man enters the machine shop and can command $12 per week, equal to the apprentice at twenty-one years of age, and very quickly makes his employment profitable to his employer. The three years in school have increased his potential value from $3,000 to $12,000, a gain of $9,000. Thus he has caught up with the apprentice entering the shop at sixteen, and who has been working for five years. Progress of the trades' school group now follows a line which diverges from that of the regular apprentice, and by the time $15.80 is earned by the regular apprentice, the trades' school graduate is earning $20, with a potential value of $20,000, or $4,200 greater than that of the shop-trained man. The trades' school line continues at substantially the same angle up to an earning capacity of $22 per week, and a potential value of $22,000.

The fourth group we will represent again by a boy of sixteen studying at school until his eighteenth year, and preparing himself for admission to one of our higher institutions of technical learning, such as the Stevens Institute, the Massachusetts Institute of Technology, Columbia, Cornell, and the like, where, after a four years' course, he is ready to begin practical work. The statistics upon which this chart is based show the average starting wage at $13 per week, or the same amount earned by the regular apprentice at the age of twenty-one and one-half and by the trades' school graduate at the age of nineteen and one-half. In other words, apparently a graduate of our technical schools has lost by his six years of preparatory study, having been beaten by the regular apprentices by six months and by the trades' school graduate by two and one-half years. From this time, however, there develops a most interesting and instructive line of progress. The regular apprentice, who is earning $13.50 a week at the time the technical graduate is earning $13, is overtaken in six months, and we find both earning $14 per week, and the technical graduate reaches the $15.80 line nearly one year before the regular apprentice. In other words, while it has taken the regular apprentice from his twenty-first to his twenty-fourth year, or three years, to increase his wages from $11.50 to $15.80 a week, the technical graduate has done the same in fifteen months.

Progress now continues on substantially the same line, and we find the technical


POTENTIAL VALUES UPON WHICH 5% IS EARNED FOR FIFTY WEEKS A YEAR
EACH HORIZONTAL LINE REPRESENTS A DIFFERENCE OF $1000.00
EACH VERTICAL LINE REPRESENTS ONE YEAR.
LABOR GROUP
SCHOOL GROUP

Potential Values Upon Which Five Per Cent Is Earned Fifty Weeks in a Year.

graduate earning $22 per week, and crossing the line of the trades' school group in three years' time, a worthy tribute to the higher education and attainment.

The line of the technical graduate now continues divergent from that of the trades' school graduate, with earning capacity regularly increasing, and a corresponding augmentation of potential or invested value until, at the age of thirty-two, or ten years after entering upon the practical work, we find our technical graduate earning $43 per week, and his potential value at $43,000. In other words, six years of preparation have enabled him to distance the shop-trained man and the trades' school graduate overwhelmingly. Bearing in mind that this is an average line, it is of interest to say that most technical graduates with a better record than the one in the chart have devoted even more time to their preparation, either by study or by shopwork, after graduation.

Thus we see clearly that preparation pays, and that it pays in dollars and cents, and that even a long term of years spent in proper study and technical training is a good investment from every point of view.

The highest wages are paid to the man through whose ability the largest number of other men may be most profitably employed. He does his work with his brain.

A practical man performs his work within the radius of his arm, a technical man within the radius of his brain. This fact is, even to-day, realized by the few, but it is gratifying to know that the number is increasing.

The technical training of an individual makes him valuable just in proportion as his ability is manifested by good judgment and perception. Trained common sense receives the highest compensation and reaps the greatest reward.

Mental ability to receive ideas and impart them properly and wisely, rearranged and grouped, is typical of the most brilliant mentality; a dull intellect may be compared to blotting paper, fit only to absorb and inter a heterogeneous mass of impressions.

The most interesting of all graphical charts would be that properly exploiting the value of technical training to manufacturing plants and enterprises. To illustrate this more clearly, we may fairly assume that the apprentice of our chart corresponds to the old-fashioned primitive shop, having practically no overhead expense, the proprietor carrying his business "in his hat," priding himself on his non-receptive sturdiness, contempt for all improvements and personal attention to all details. For his costs he adds together the value of raw materials and labor, and then adds a few dollars for profit. The line of this establishment would parallel the $15.80 line of our shop-trained group.

The trades' school line on the chart truthfully represents establishments in which some attention has been paid to the improvement of the system, with an increased so-called non-productive force, operating possibly in some particulars with brilliancy, but with defective features in others; acknowledging the value of improvements if internally originated; moderately but unconsciously absorbent of ideas from without, but tenacious of dogma and lacking departmental symmetry. Growth, increased earning and relative immunity from disastrous failure result.

The technical graduate line of our chart represents the manufacturing establishment technically trained and "abreast of the times" in all particulars, and I predict a time not very far distant when it will be almost universally recognized that establishments should be trained as well as individuals, and that the marvelous development in scientific shop practice and management will do for the manufacturer fully as much as technical training is doing for the individual.

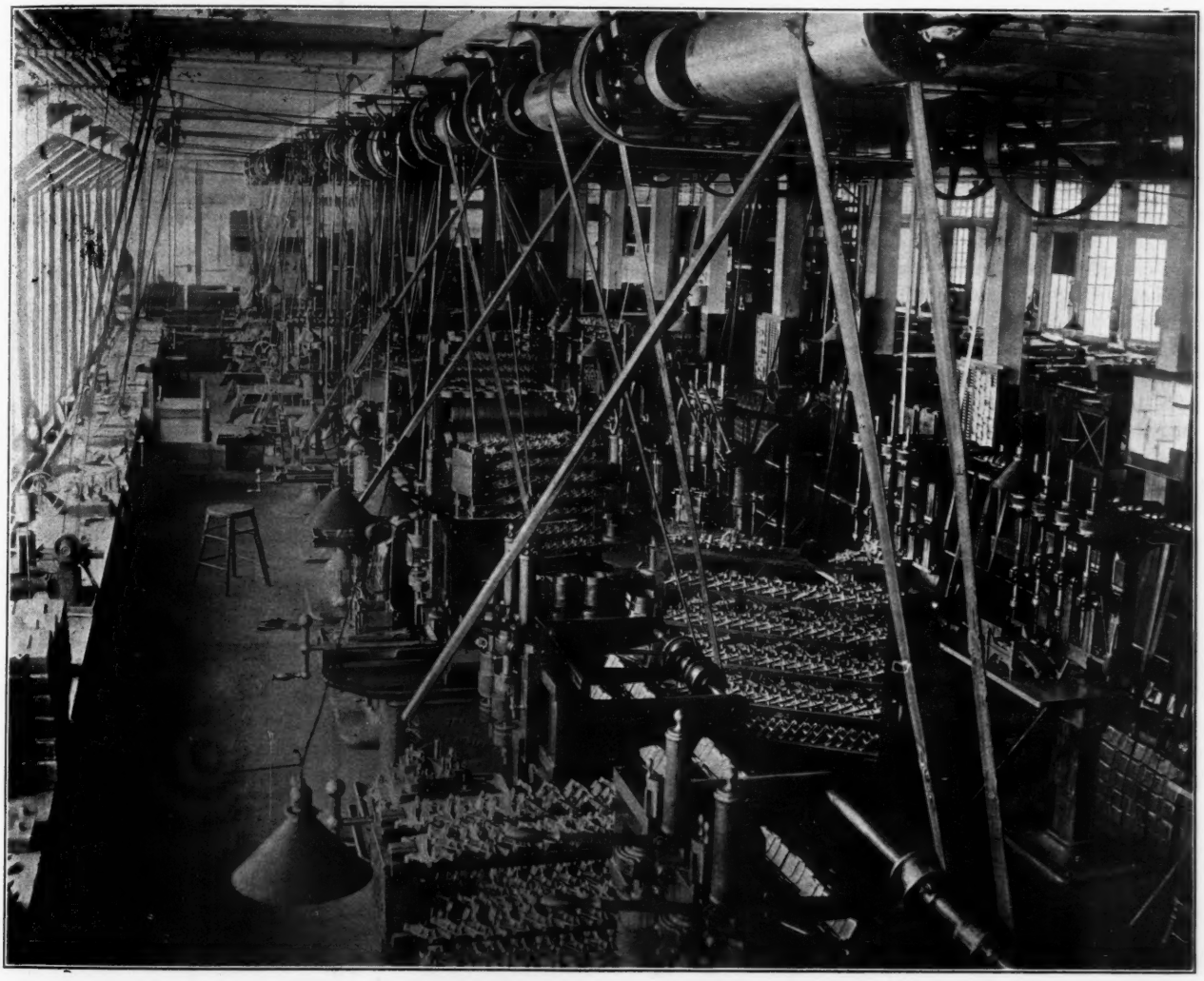
Making an Integrating Wattmeter.

Some Points in the Construction of the Stanley Wattmeters, and Some Views of the Stanley Instrument Company's Works.

THE Berkshire Hills of Massachusetts are reputed to be one of the most healthful and most beautiful spots in the New England States, and it was to this locality that William Stanley was sent some years ago, when his health had broken down and but few expected him to recover. To this incident may be attributed the location and the building up of two important industries in the electrical field. One of these with which Mr. Stanley is now identified is at Great Barrington, where are made the Stanley recording wattmeters, known all over the world for their accuracy and reliability. The construction and testing of this meter present points of considerable interest which are well worth description.

The supplying of electricity, be it for light or power, is daily becoming more and more important, and the measuring of this power is daily becoming a more essential part of the supply company's business. The old, crude system of supplying power at so much per lamp per month or per horse-power per year has given way to the more sensible and satisfactory system of paying by the meter. The wattmeter thus becomes equally important to the consumer and the supply company. Upon its operations depend the consumer's bills and the supply company's income. For this reason it is essential to have meters which are accurate and which will remain accurate, and it was to meet this need that the Stanley meter was designed.

While it is a simple matter to construct an instrument which will record, after a fashion, the power passed through it, it is not easy to make a meter which will record accurately day in and day out, under all variations of load, and which will not require attention or adjustment from time to time. A meter should record accurately the power passed through it, whether this is being supplied for one lamp or fifty, and it should not creep—that is, it should not turn when no current is being drawn from the circuit supplied through it. The meter should not be unduly large, it should require but little power to operate it, and it should retain its accuracy for a considerable time. To meet these requirements, the moving part of the meter should be as light as possible; friction should be reduced to a minimum and should remain constant—this means that all parts must be constructed with the greatest accuracy, and



MACHINE SHOP MAIN FLOOR, STANLEY INSTRUMENT COMPANY, GREAT BARRINGTON, MASS.

all unbalanced forces must be eliminated.

Undoubtedly the most important of these requisites is the reduction of friction, because the only mechanical work of any consequence required of a meter is to overcome its own friction. If the friction to rotation is large, compared with the power recorded, the meter not only consumes an undesirable amount of energy itself, but slight variations in this friction will cause considerable variation in the accuracy of the meter, as the meter will always be working against the frictional resistance, which does not vary with the power passed through it, it will respond less readily to slight variations in this power. For this reason it has been the aim of all meter designers to reduce the mechanical friction to the lowest possible amount.

In a meter the most important moving part is the disc, the other moving part being the recording train. The proper construction of these parts calls for the highest mechanical skill, and in this work the meter-making companies often vie with, and even surpass, the best watch manufacturers. As the disc is the largest moving piece, and as its speed is much greater than that of any part of the recording train, the friction opposing its rotation forms the most important part of the whole, and may often mask that offered by the recording train. To the problem of reducing this friction the greatest attention has been paid, and it is in this respect that the Stanley magnetic suspension meter differs most radically from other makes.

Corner in Paint Shop, Painting Finished Meters and Parts.

The designer of this meter was not content to use jewel bearings constructed with the greatest care, but he decided to eliminate such bearings for supporting the disc. To accomplish this he devised the so-called magnetic suspension. In the magnetic suspension the disc is not held in position by jewel bearings, but its weight is entirely supported by an ingeniously constructed permanent magnet. The disc, which is a circular disc of aluminum, stamped and pressed in one operation, is mounted upon a hollow steel core, having at its lower extremity a projecting collar. This core is turned with the utmost nicety, and must not vary in diameter more than two-ten-thousandths of an inch.

The magnet which supports the disc by attracting this core is of steel, with two steel pole bushings. The upper of these bushings is drilled to admit the upper end of the suspension core, while the lower bushing is cup-shaped, having a projecting rim which just admits the collar on the lower end of the core. The clearance between the two bushings and the two ends of the core is just sufficient to allow the core to revolve when held centrally, without rubbing. The attraction of the magnet upon the core lifts it up until the collar lies nearly in the plane of the flanged lower bushing. While in this position the core and its disc are held centrally by a very fine wire passed through guides within the two bushings and through the core.

Corner of Main Floor, Showing Part of Stockroom, Transformer Winding Benches, Etc.

The mechanical work just here is probably the finest done on the meter, as lateral motion of the disc must be avoided as far as possible, and yet sufficient clearance must be given the wire so that it will act as a guide for the core, and not a spindle upon which it revolves. The wire and the hole through the core must not vary more than two-ten-thousandths of an inch. This method of suspension, the engineers of the Stanley company believe, reduces the friction opposing the rotation of the disc to a minimum. But to obtain the full advantage of this construction, it is necessary that all forces acting upon the disc be carefully balanced, so that the driving force acts in the plane of the disc and at its point of application is normal to the radius. The disc is therefore carefully balanced, so that the centre of gravity lies in the centre of the core, and the

driving coils and the brake or retarding magnet are both arranged symmetically with respect to the disc.

If the shunt and series coils are not arranged symmetrically with respect to the disc, the force due to the reaction of the

Corner in Testing Room, without Operators.

currents induced in the disc by the varying fields set up by the coils will not have a direction coincident with the plane of the disc, and there will be a downward or upward thrust acting upon the disc and tending to throw it out of line. To eliminate this undesirable feature, there are four shunt or field coils and two current or series coils in the Stanley meter, arranged symmetrically above and below the disc and placed so as to produce a uniform field.

While this arrangement of coils eliminates any upward or downward thrust upon the disc, it does not do away with a side thrust caused by the direction of flow taken by the eddy currents in the disc. These currents would not normally flow across the pole along radii, and there would, in consequence, be a side thrust. This effect is prevented by closed circuited copper rings placed over the side of the shunt pole nearest to the edge of the disc, whereby a compensating force is set up which balances the side thrust.

A third undesirable reaction is also eliminated by the symmetrical arrangement of the series and shunt coils. As explained above, an upward or downward thrust exists where the field is not symmetrical, and since the currents induced by the alternating field are not in phase with the field, this thrust varies both in direction and amount, thus tending to throw the disc into vibration, as well as increasing its friction. Both effects, however, are eliminated by the symmetrical arrangement of the driving coils adopted.

In the construction of these meters the aim has been to eliminate friction as far as possible, rather than to compensate for it. Since the moving disc is light and perfectly balanced and is not subject to disturbing forces, but a small torque is necessary to set it in rotation. No starting device is needed, as the meter will begin to revolve and will register accurately, even upon the smallest loads.

Another detail of construction in these meters which has received considerable attention is the design of the brake magnet. These magnets, as well as the supporting magnets, are of special steel, carefully magnetized and seasoned, and they are all tested for the proper degree of magnetization before being used. The brake magnet is held by the supporting frame in such a way that the expansion and contraction due to changes in temperature will not cause any variation in the length of the air-gap. This length is adjustable by means of a screw bushing in the pole, and this means is made use of to adjust the meter, so that it will rotate at the proper speed.

Having seen how the mechanical friction of the disc has been reduced to a minimum, it is well to turn to the recording train and notice the means used here for accomplishing the same purpose. The only useful work performed by the meter is that of driving the recording train, and while these gears revolve at relatively low speeds compared with the disc, it is important to reduce the friction of the train as much as possible. The ideal meter would be one in which there was no mechanical resistance whatever, as the mechanical resistance offers a constant retarding force, while the retarding force in an ideal meter should be proportional to the speed of rotation. For this reason the principal retarding force in practically all recording meters is that due to the eddy currents set up by the braking magnet; and the smaller the frictional resistance compared with this force, the more sensitive the meter. In the Stanley

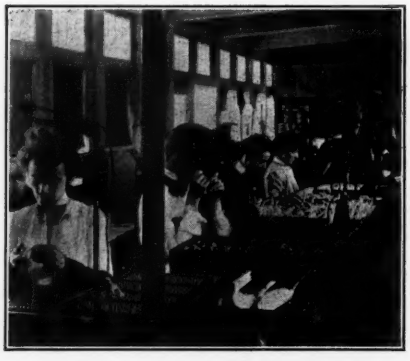
Assembling Magnetic Suspension and Balanced Thrust Meters.

meter the friction of the recording train is reduced by careful, accurate gear cutting. These gears are cut from blanks stacked on a mandrel by involute cutters which themselves have been generated. The curves of the teeth are then as nearly perfect as it is possible to make them, and are not close approximations such as would result from designed cutters.

It would be apparent that, in constructing a meter such as the Stanley, the greatest care must be exercised at all times. Every piece must be inspected and tested before going into the meter. For the finest work—that of making the suspension core—accurate gauges are used. Where exceedingly delicate work is required, multiplying gauges are employed. In this work all that could be learned from methods used in watchmaking was available; but much of the work is even more delicate than that thought necessary in watchmaking. A gear filed out by hand or stamped out by a die can not be as accurate as one cut by machinery with a carefully prepared cutter.

The electrical parts of the meter do not require such exact mechanical work, even were it possible to use such in these parts. The meter has two series or current coils, and four shunt coils. These are wound carefully on formers, attention being paid to securing the proper insulation. The series coils are wound from a bare copper strip of a definite length, the adjacent turns being insulated from each other by paper tape. The shunt coils are formed by winding a definite number of turns of insulated wire on a spool. These are then coated with an insulating varnish and are placed upon a laminated core. Each coil is inspected several times and tested before being accepted for the stock-room.

In the design of an induction meter it is important that the accuracy of the meter be not affected by the power-factor of the circuit which is drawing its supply through the meter. For a meter to be accurate on all power-factors ,the magnetic field set up in the air-gap by the shunt coils must be in quadrature with the electromotive force. If the lag on the flux is less than ninety degrees behind the electromotive force of the circuit, the meter will run slow on loads with a low power-factor or lagging current, and fast when the current leads. If it were possible to wind a shunt coil of a sufficient number of turns without any appreciable resistance, and if all losses in the iron core could be prevented, there would be no difficulty in securing this quadrature relation; but these conditions do not obtain in a meter that will be commercially practicable. This quadrature relation can, however, be obtained by modifying the shunt magnetic circuit. A magnetic bridge is arranged so as to shunt part of



CORNER IN INSPECTION DEPARTMENT WHERE ALL PRODUCT IS EXAMINED.

the flux set up by the shunt coils. This causes an additional lagging of the flux in the air-gap which is beyond the magnetic shunt, and by properly adjusting the length of the air-gap in this magnetic shunt circuit, the flux in the air-gap can be brought exactly into quadrature with the electromotive force of the circuit.

The parts of the Stanley meter are made as nearly alike as possible and are kept in stock, each piece having passed through several critical examinations before being accepted. The next stage in the construction of a meter is assembling,

TRUCK LOADS OF FINISHED METERS GOING TO SHIPPING DEPARTMENT. TRUCK LOADS OF PARTLY COMPLETED CASES AND FRAMES.

and great care must be exercised in putting together and adjusting these delicate parts, so as to get each exactly in its proper place. From the assembling rooms the meters are passed to the testing rooms. Here they are first examined and adjusted by passing through them a constant load for short intervals. When they have been adjusted as closely as possible, they are then given a test for determining the accuracy, and after that are put on the time test and run. For testing and adjusting the meter, the testing room at the Stanley shops is provided with circuits carrying different loads and different frequencies. At each table the operator can cut in the meter to be tested without disturbing any other operator. The load on each circuit is kept at a predetermined value by operators in another part of the room, so that there is no need to make any measurements at the meter. All that is necessary is to time the speed of the disc by a stop watch. Much, of course, depends upon the accuracy of the watch, and to keep a check on this each watch is tested before and after each day's work. The meters are tested at the frequency for which they are constructed at several loads and at power-factors of unity and one-half, the latter test being more severe than they are required to stand in practical operating conditions.

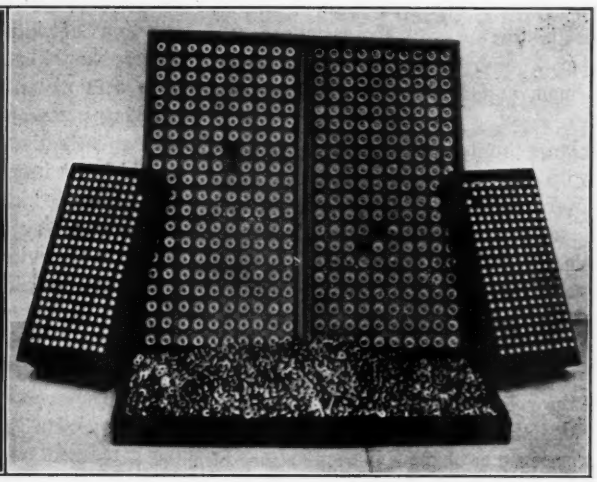
After adjusting and testing the meters, it is desirable that they should be sealed up to prevent any tampering. With the Stanley magnetic suspension meter this can be done, as there is no jewel to be injured by jarring or pounding of the disc during transportation. The users of these meters are not supposed to touch them after they have been put in place. The meters are shipped ready for attaching the wires, and they are guaranteed to retain their accuracy for three years without being adjusted.

The meter thus far considered is that which the Stanley company believes to be the most perfect recording wattmeter which has yet been put upon the market. There has, however, been a constant demand for a less expensive meter. Some of the electrical supply companies do not believe such extreme accuracy in measuring their product is necessary. For such cases the Stanley company is now making a meter on practically the same lines as the magnetic suspension meter, except that this suspension is omitted, and jewel bearings used. The same care is exercised in eliminating undesirable forces acting upon the disc, so as to prevent any strain on the jewels, except that due to the weight of the disc and its pinion. To prevent injury to the lower jewel, caused by vibration, this is mounted on a spring support which absorbs shocks and jars. These meters are calibrated to highest accuracy when sold; but, though the company believes they are subject to less wear than other jewel meters, it does not believe that any jewel

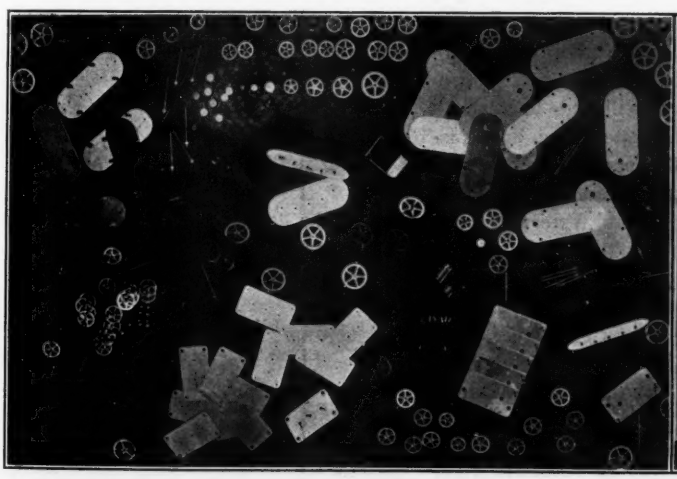
meter can maintain its accuracy for long periods as does the magnetic suspension meter.

So far attention has been directed to certain details only in the construction of the Stanley meter, but it will be appreciated that where such care and exactness are necsessary in all stages of the work, the organization of the shop must be particularly well carried out. The illustrations given indicate, to some extent, how well this has been done at the shops of the Stanley Instrument Company. All the work is systematic and all the parts standard, for having secured a good design for a meter, the next step toward turning it out in quantity is standardization. This is necessary not merely for the sake of reducing the cost, but that there may be the least possible variation from the prescribed dimensions. The employment of highly skilled labor and the use of special tools whenever possible contributes much to this end. All parts of the Stanley meters are standard; they are made in quantities and kept in stock to be issued for assembling into meters as desired.

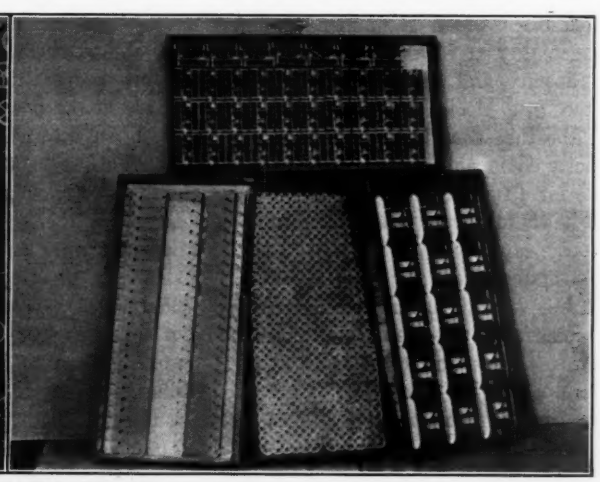
GROUP OF SPECIAL TOOLS AND GAUGES.



TRAYS CONTAINING SOME PARTS OF MAGNETIC SUSPENSION.



TRAIN PARTS.



TRAYS CONTAINING TRAIN PARTS.

Worcester Polytechnic Institute.

The high-potential transformer built by the electrical engineering department of the Worcester Polytechnic Institute in 1898 under the direction of Professor Harold B. Smith, the head of the department, has recently been sold to Mr. C. S. Knowles, of Boston, and has been sent by him to New Lexington, Ohio, for installation at that place. It will be used in connection with the high-voltage porcelain works in which Mr. Knowles is interested.

The transformer has already been installed and is now ready for testing work. The installation was performed by Messrs. J. A. Sandford and W. T. Goddard, assistants to Professor Smith in the electrical department of the institute. This transformer has, since it was built, been an object of considerable interest in electrical engineering circles, and enquiries have been received by Professor Smith respecting the details of its construction from all parts of the United States, and also from abroad. Its capacity is 150,000 volts, with a frequency of sixty, and, as is well known, this is the first transformer ever built in which so high a voltage was attained which could be successfully used for commercial purposes. The transformer was from the first entirely successful, and amply fulfilled the expectations entertained by Professor Smith when he first designed it. In searching for apparatus with which the necessary testing could be done, Mr. Knowles experienced great difficulty in obtaining satisfactory estimates from the different electrical companies; hence negotiations were opened with Professor Smith which finally resulted in the purchase of the transformer belonging to the Worcester institute.

It will be replaced immediately at the Worcester Polytechnic Institute by the construction of a new transformer which will contain a number of improvements. These have been devised during the experience of the electrical engineering department in high-potential work during the last five years. Mr. Sandford will remain at New Lexington where he will be engaged for some time conducting a series of experiments involving the use of high potentials.

The Electrical Committee of the Underwriters' National Electrical Association.

The electrical committee of the Underwriters' National Electrical Association, which is the body which prepares the rules of electric wiring for the National Board of Fire Underwriters, held its meetings in the room of the New York Board of Fire Underwriters, 32 Nassau street, December 2 and 3, Mr. F. Elliot Cabot, chairman, and Mr. C. M. Goddard, secretary.

A large number of electricians connected with the insurance companies from all over the country were present, and also members of the national conference on electric lighting rules, the code committee of the American Institute of Electrical Engineers, and officers of the National Electrical Contractors' Association. It is the custom at these meetings to go over the rules for the purpose of making any amendments from the developments of experience or changes in applications of electricity during the past year. At this meeting the amendments were few in number and the policy of the committee governing the proceedings appears to be a deviation from the former methods of attention to details and a larger and greater weight to the general principles of results to be obtained. The principle amendments adopted were in the line of improvements in rosettes with knob and cleat work. A report was submitted by the committee on the standardization of enclosed fuses which recommended interchangeability of fuses of the same carrying capacity, and also the standardization of the fuse blocks in different sizes so that the tube containing a fuse of given capacity could only fit in a type of block made for a fuse of that capacity, in order that it would not be possible for fuses of too large capacity to be inserted in blocks for a smaller size.

In this work the committee has received the cooperation of the largest manufacturers of fuses and of electric lighting apparatus. The committee was given more time to complete a series of tests which had been laid out, and the results of which will be embodied in a later edition of the rules.

A committee on car rules presented a report of progress which states that it was in conference with a committee of the American Street Railway Association.

The proposed rules for protective car wiring contemplated making arrangements for the protection of the under side of the car above the electrical apparatus by fire-resisting material; the use of stranded conductors, and for all exposed conductors a flame-proof outer covering; the use of approved switches, cutouts, etc., with those having exposed metal parts which were connected with a circuit located in cabinets; and running of wires in metal conduit or any other methods protected by fire-resisting material; the abolition of cluster lighting and the substitution of individual lamps; electric heaters should be so placed that there will be a safe distance between the current-carrying parts and the woodwork of the car; and finally the design of terminals should be so improved that loose contacts may be avoided.

The secretary stated that the amendments to the rules of a year ago, particularly those providing against the hazard of extra high-potential circuits, had been promulgated and were thus far exceedingly satisfactory in their results.

At these meetings the proceedings are kept closely to the subject in hand, and the concentration of practical experience in electrical affairs over a wide range of the applications of electricity throughout the United States renders their deliberations very much to the point.

Water Powers on the Kennebec River, Maine.

The United States Geological Survey has recently completed a survey of the Kennebec river from tide water at Augusta to Moosehead lake. This survey shows the occurrence and location of a number of fine undeveloped water powers. In almost every place where there are plants in operation from one-half to two-thirds of the power still goes to waste.

At Augusta a seventeen-foot dam furnishes about 20,000 horse-power, of which only 4,000 horse-power is used. Eighteen miles up the river, at Waterville, two dams use only a trifling part of an available head of forty-two feet, and at Fairfield not more than one-tenth of the power of a sixteen-foot dam is employed. The same is true of the twelve-foot dam at Shawmut. At Skowhegan, where there is a fall in the river of twenty feet, only 7,000 horse-power is used.

Between Norridgewock and Madison there are sites that present fine opportunities for power development. For twenty-four miles above Solon there are a great many rapids and shoals, which have a total fall of 160 feet. Three miles above the forks, the last settlement up the river, is the first power, on Moxie stream, with a vertical drop of eighty-five feet. For four miles below Indian pond the river gorge is very narrow, with walls about 200 feet high. In this distance there is a fall of 190 feet, with several excellent sites for power development. The outlets of both Indian pond and Moosehead lake are controlled by crib dams that regulate the water for lumbering purposes.

The survey was made by Messrs. A. T. Fowler, John C. Hyer, and T. J. McMaugh during last summer. In addition to making a complete map plan of the river, showing all the islands and the position of the hills on either side, the party made accurate determinations of the height above the ocean of the top and bottom of each rapid and fall. They left permanent bench marks on which future surveys may be based. The elevation of Indian pond was found to be 933 feet and of Moosehead lake 1,029 feet.

Electrotechnical Industry of Germany.

[*From United States Deputy Consul-General Hanauer, Frankfort, Germany.*]

An essay on the electrotechnical industry of Germany, written by Dr. Brüner, the syndic of the Association for Fostering the Interests of German Electrotechnics, gives the following data: Germany's output of the electrotechnical products during the year 1898 aggregated 228,670,000 marks ($54,423,460) in value, of which 57,000,000 marks ($13,566,000) was for foreign orders. The value of the exports of electrotechnical products rose to nearly 100,000,000 marks ($23,800,000) in 1902, although the total production decreased considerably in that year.

The total amount of capital invested in German electrotechnical works and enterprises in 1900 amounted to 2,500,000,000 marks ($595,000,000). The greater part of this sum has since been wiped out by the depreciation of the share capital. Many of the enterprises inaugurated and conducted for their own account by the electric manufacturing companies proved unprofitable and had to be given up, nearly all the capital invested becoming a dead loss. Among these ventures electric railroads in mountain districts and tramways and lighting plants in the smaller towns form a large proportion of the losses.

The *Electrotechnical Journal* says that the increase of electric roads in Germany during 1902 was about 300 kilometres (186 miles), with an additional 400 kilometres (248 miles) in course of construction. The number of motor cars is estimated at 12,500, against 7,300 in 1901, and their power capacity at 30,000 kilowatts, against 25,530 kilowatts in 1901.

NOTES ON X-LIGHT.

BY WILLIAM ROLLINS.

NOTE CLXXIV—RADIANT AREA FINDER.[1]

In earlier notes X-light tubes in which the walls were the source of X-light were recommended for therapeutic purposes; the form and position of the cathode determining the position and size of the radiant area. Before using such tubes, it is desirable to test them to see if the X-light is given off from the calculated area. For this purpose, a brass tube covered with lead and containing diaphragm plates and a fluorescent screen is useful. The tube is one metre long and twenty-five millimetres in diameter. At one end there is a diaphragm plate D with a hole five millimetres in diameter. A similar plate is placed at D2; the fluorescent screen at FS; a circular plate of heavy lead glass at LG, to protect the observer from the X-light. One eye is applied to the eyepiece EP of the tube, which is directed toward the radiant area, until a round spot of light is seen on the fluorescent screen. The other eye looking through the glass plate sees the direction in which the tube is pointed, which is the line of the ray of X-light. By moving the tube about, a mental picture is obtained of the size and position of the radiant area. In earlier notes the necessity of using the X-light tube in a non-radiable box was shown, no X-light being allowed to strike the observer. When investigating X-light tubes this box cannot always be used. In these cases, the observer must protect himself in the way already recommended by non-radiable coverings. In note xlv, a covering of this kind was described which was made by coating cloth with a flexible non-radiable paint. As one person has thought well enough of this idea to ask for the formula for the paint, it is given here:

FLEXIBLE NON-RADIABLE PAINT FOR COATING CLOTH COVERING TO PROTECT FROM X-LIGHT.

White lead paint..... 9 pounds
Soap..... 2½ ounces
Water.....12 ounces

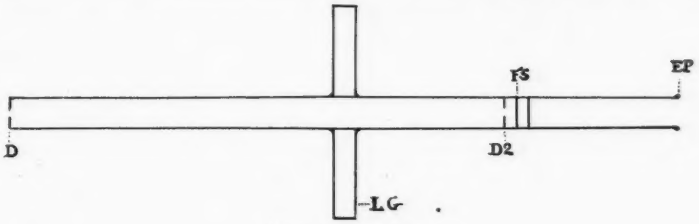
Heat the water to 212 degrees Fahrenheit, dissolving the soap in it. Pour the mixture while hot into the paint, stirring until well mixed. As this paint comes off slowly after a time, a better way is to mix dry powdered white lead with rubber dissolved in benzole, spreading the mixture between two sheets of cotton cloth, which are then pressed together. This method protects the non-radiable coating.

If lead is considered undesirable a bismuth compound can be used mixed either with a drying oil or rubber dissolved in benzole, but a greater thickness is required. November, 1903.

The idea of using paint of this kind as a protection from X-light occurred after seeing it employed by Mr. C. A. Welch on the coverings for sails, which need to be flexible and waterprof. Experimenters with X-light will find a long white duck coat, of the kind used by marketmen, a convenient garment when coated with this paint. A pair of white cotton or thin rubber gloves, recommended in earlier notes, should also be painted in the same way and used to protect the hands. They soon break up the unwise habit of employing the hands as a test of the strength of the X-light. The lower parts of the body are easily protected from the direct X-light by a non-radiable table placed below the tube which is being studied, as the shadow it casts covers them.

NOTE CLXXV—DESIGNING X-LIGHT TUBES.

The tube shown in Fig. 1 is of the type illustrated and described in note cxxxviii.



NOTE 174.—FIG. 1.

The centres from which the curves are struck and the length of the radii are given. The vacuum regulators operate on the principle first embodied in my tubes and later described in this series of notes, that of having two regulators, one a regenerator[1] to permanently lower the resistance of the tube, the other to lower the starting resistance and then automatically keep the working resistance of the tube at any desired point. The importance of being able to always regulate the light during an examination is so great that it has been much dwelt upon and made into an X-light axiom.

In the tube shown in Fig. 1, both regulators are operated by the generator used to excite the X-light tube. When the tube is to be used, the regulators are arranged as shown in Fig. 2. The current then does not go through the permanent regulator. It goes from the electric generator through the arm A to the wire B, the spark-gap S, the automatic regulator AR, the stem of the terminal C to the electric generator. The regenerate the tube, the starting resistance is reduced to any determined point, for example, 150 millimetres by the automatic regulator to prevent risk of puncture. The stem A is then lifted quickly (to the position of the dotted line A2), the regulator HR put into the circuit (by turning the arm HW down into the position shown by the dotted line HW2); the current going through the stem of the terminal T, the wire HW3, the regulator HR, the wire HW2, the wire B, the spark-gap S, the automatic regulator AR, the stem of the other terminal (C) to the electric generator, until the resistance of the tube is less than 150 millimetres, when the current will leave the regulator and regenerator circuits, passing through the X-light tube between the faces of the terminals, the regulators ceasing to operate. The arm HW2 is then raised, cutting off the current from the regulator HR. The arm A is brought in contact with the terminal disc TD, fully described in earlier notes. The current then goes through the automatic regulator; the resistance of the tube being maintained at any point less than 150 millimetres by the length of the spark-gap S which is controlled by a handle RH4 (note cxlvi, Figs 5 and 5A), and described in note clii. The handle is within reach of the operator while making an examination or taking a photograph. The kind of X-light can therefore be varied without interrupting the examination. As the X-light tube is intended for use in a tube box (illustrated in note clvi), provision must be made to prevent the spark-gap from cutting off any of the X-light escaping through the openings of the diaphragm. In the tube illustrated in note cxxxviii this was effected by having the stem of the target arranged to allow the latter to face in several directions. If this idea is not used, the spark-gap tube should be placed at an angle. The regulator and regenerator are both somewhat alike in appearance. One contains a chemical which liberates a gas

[1] No originality is claimed for the principle of this finder.

[1] As it seemed possible that one cause for the deterioration of X-light tubes by use might be that some of the charged particles formed during the action of the tube pass out through the glass well, the tubes were kept in an enclosure with radium salts to see if the charged particles shot off from the radioactive material might not by passing into the tube supply the loss. The experiment should be repeated now with pure radium bromide which can be purchased by any rich person.

that it reabsorbs, while the other liberates a gas which it does not reabsorb. The tubes in which chemicals are placed are shown in Figs. 2 and 3. Each form has a platinum wire sealed into one end. Another wire may be sealed into the other end, or the end may be open, the openings serving for the introduction of the chemical, in a powdered state mixed with a conducting substance, gold foil, for example, as described in note cxxxix. The opening, whether in the side or end, is closed with spun glass. This construction of regulators and regenerators is useful in experimenting with gases, helium, for example, which are contained in minerals, as the high temperature produced in the interior of the powdered chemical by the current as it jumps from one bit of conducting material to another is efficient in liberating the gas. The tubes are to be heated in an oven before being used. If any material collects on the outside, it is to be removed before sealing into the X-light tube; particular attention being paid to having a free passage for the gas through the spun glass plugs.

In Fig. 3 is shown a cooled target tube constructed on the same design as the tube illustrated in Fig. 1.[1] If it is desired to construct a tube with three terminals on the principle first recognized in these experiments of having the target separate from the anode (though capable of being connected with it) and nearer the cathode, the third terminal may be placed as shown by the dotted lines in Fig. 1. For further details as to this type of tube refer to notes iv, xvi, xxxi.

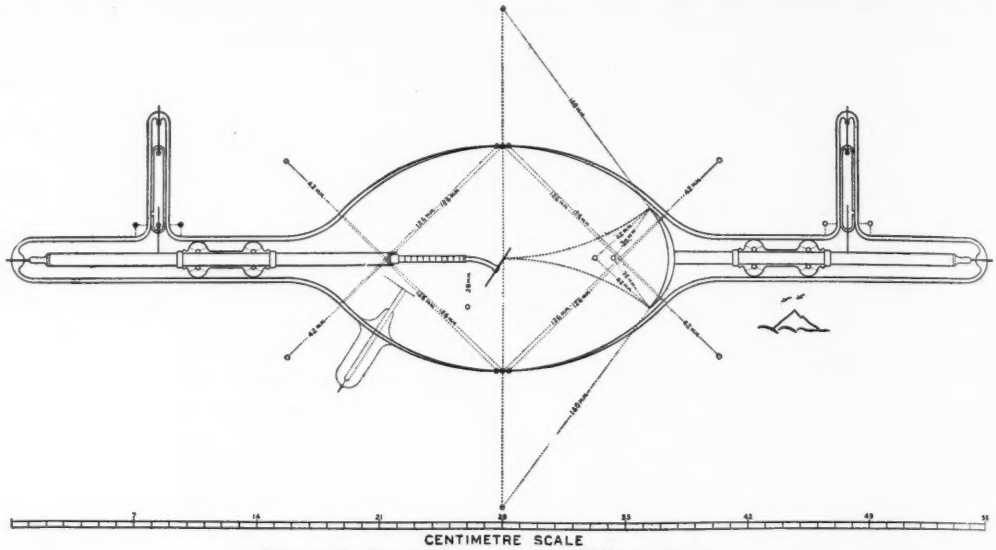
This principle has been extensively adopted by several makers of tubes and such tubes are the most common forms now both in America and Germany.

NOTE CLXXVI—ON THE MEDICAL USE OF SOME OTHER ETHER MOTIONS BESIDES X-LIGHT.

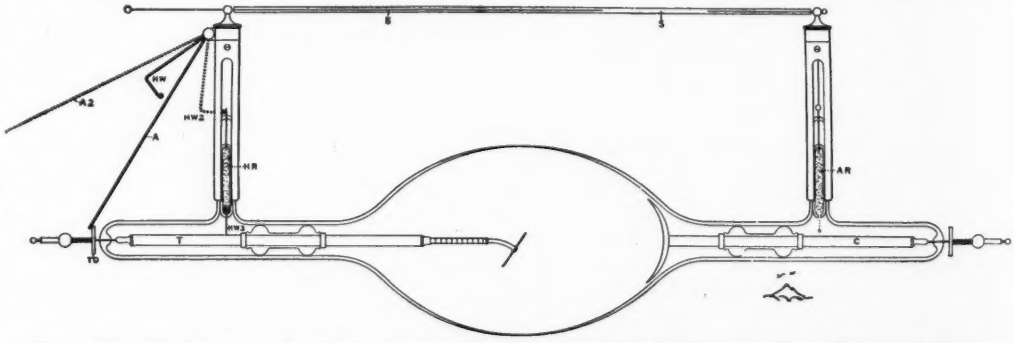
In the Boston *Medical and Surgical Journal* for February 25, 1897, attention was called to a method of reducing pain and inflammation by sending a high-voltage current directly through the tissues by connecting the patient with both terminals of the electric generator. Since that time the method has been in constant use, thereore it will be mentioned here, though not an X-light treatment. The procedure is painless if the terminals of the generator are of proper size for the amount of current and are in direct contact with the patient while the current is passing. In the note mentioned, a simple foot switch was recommended for starting the current after contact, and stopping it before the contact was broken. This is important as the treatment often requires to be of considerable length, making it convenient to have the patient able to control the current to save the physician's time. The experiments were made because it seemed possible to electrically produce and maintain a condition of the ether which would prevent the transmission of unwise messages by the nerves, and yet allow useful ones to be sent.

In note xxx and subsequent notes it was said an X-light tube produced not only ether waves which were X-light, but longer waves down to and below those of ordinary light. Here is pointed out the value of some of these waves in the treatment of disease. The experiments have been chiefly confined to the lower animals, but a limited experience with man has shown the value of the method in skin diseases.

The waves may be produced from vacuum tubes of the type recommended in some earlier notes for therapeutics. The cathode should not bring the Varley stream to a focus, as a small area of radiant energy is not required, for definition is not sought. The cathode stream particles should strike either a broad metal target or the interior wall of the vacuum tube. The area of impact should be sufficient to prevent injurious heating, the size varying with the diseased area to be treated. The impact gives rise to ether (electromagnetic) waves longer than those of X-light, because the velocity of the impact of the cathode stream particles is less than in an X-light tube, owing to the less exhaustion of the ter-



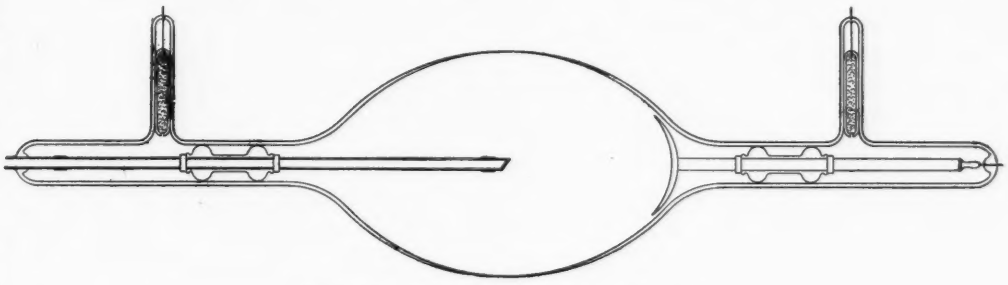
NOTE 175.—FIG. 1.—DESIGNING AN X-LIGHT TUBE.



NOTE 175.—FIG. 2.—METHOD OF OPERATING THE REGULATOR AND REGENERATOR OF AN X-LIGHT TUBE.

[1] Refer to note i.

minals and the greater density of the atmosphere of the tube. This treatment is to be distinguished from that of X-light, ultra-violet light, violet light, ordinary light, heat and high-frequency waves, as the ether motions are not the same. In treating skin diseases less care is required than with X-light to avoid injury to the tissues, as the burns which can be produced are less serious and more superficial. On the other hand, the treatment may be extended to a greater depth than with Finsen light. It requires less electrical energy, for the proportion of heat waves generated is smaller and the source of waves can be almost in contact with the skin. Tubes for producing these waves are less expensive than X-light tubes, as the prolonged electrical treatment of the terminals is not required. The resistance of the tube should be too low for X-light to be produced. The tubes should be given forms suited for the areas to be treated. The area from which the waves arise will be determined by the form of the cathode which should be constructed in accordance with the results of the experiments mentioned in earlier notes. Precautions should be taken to protect the patient from other radiations, charged bodies and electrons, when these are not wanted.



NOTE 175.—FIG. 3.—COOLED TARGET TUBE.

NOTE CLXXVII—A GROUPING OF SOME OF THE AXIOMS MENTIONED.

In an X-light tube the space enclosed by the glass walls should vary directly with the rate of using electrical energy in the tube.

In an X-light tube the size of the cathode should vary directly with the rate of discharging electricity from its face, and with the size of the surges.

In an X-light tube the target should be cooled when it is struck by a powerful cathode discharge.

In an X-light tube the target should be placed at the focus of the cathode discharge.

In an X-light tube the distance between the cathode and the target should be capable of variation, or there should be an automatic regulator.

In pumping X-light tubes the X-light should not strike the observer.

In pumping X-light tubes they should be enclosed in a non-radiable oven.

In pumping X-light tubes water vapor should be excluded from the pump.

In pumping X-light tubes mercury should be kept out of the tube.

In pumping X-light tubes the removal of the gases is but a part of the work, the value of the tube depending also on the electrical treatment of the terminals.

In pumping X-light tubes they should be hot, and the pump should be warm.

In pumping X-light tubes the necessary amount of gas should be removed from the glass and the interior of the tube before they are electrically taken from the terminals.

In pumping X-light tubes the absence of leaks should be ensured before the electrical treatment of the terminals begins.

In pumping X-light tubes the amount of electrical energy to be afterward used with the tube should be known, the terminals being treated to bear that amount.

In using X-light the source should be in a non-radiable tube box from which no X-light can escape except the smallest beam which will serve the purpose.

In using X-light it should not strike the observer.

In using X-light selective filters should be employed to strain out undesirable radiations.

In using X-light, the fluorescent screen should be covered on the side toward the observer with a plate of heavy lead glass as a protection from the X-light.

In using X-light with a cryptoscope, the walls of the instrument should be non-radiable to prevent the entrance of X-light except in the direct beam.

In using X-light with a fluorescent screen, whether open or enclosed in a cryptoscope, the surface of the screen should be held normal to the central ray of X-light employed.

In making photographs by X-light, only the beam arising from the radiant area of the target should be allowed to strike the photographic plate.

In making photographs by X-light, the central ray of the beam of X-light employed should strike the photographic plate normal to its surface.

In making photographs by X-light, the place where the central ray of the beam employed strikes the plate should be automatically recorded on the negative.

In making photographs by X-light, the position and distance of the source of X-light should be automatically recorded on the negative.

In making photographs by X-light, the object being photographed should be enveloped in a non-radiable covering which will admit only the X-light in the direct beam employed.

In using X-light in medicine, the examination room should be fumigated every night.

In using X-light in medicine, the apparatus should be sterile.

In using X-light in medicine, none should strike the patient except the smallest beam which will cover the area to be examined, photographed or treated.

In using X-light in diagnosis, to avoid undue exposure of the patient, the X-light should be produced in surges, each of the shortest possible duration, with as long periods between as are compatible with a light apparently steady, advantage being taken of the persistence of vision and of luminescence. The more luminescent the salt of the fluorescent screen the shorter the surges may and should be, with moving organs like the heart and lungs.

In using X-light in medicine, the physician should be able to make all the adjustments of the light without removing his eyes from the images on the fluorescent screen.

In using X-light in medicine, the physician should be able to orient himself in relation to the patient and the source of X-light at all times during an examination without removing his eyes from the image on the fluorescent screen.

In using X-light in therapeutics, its waves should be such as are most absorbed by the diseased tissues.

In using X-light in therapeutics, the waves should be as long as can be employed without injury to the overlying tissues.

In using X-light in therapeutics, the distance of its source from the surface of the body through which the X-light enters should vary directly with the distances of the diseased tissue below that of the surface.

In using X-light in therapeutics, the distance of the diseased tissues below the surface of the body through which the X-light enters should determine the form of vacuum tube to be employed.

In using X-light in therapeutics, the nearer the diseased tissue is to the surface of the body through which the X-light enters, the nearer the source of X-light should be to the nearest wall of the vacuum tube.

In using X-light in treating diseases of the outer surface of the body, the X-light tube should be in a portable non-radiable case from which no X-light can escape except toward the diseased tissues, the tube box being provided with a handle to allow the tube to be moved over the diseased area.

In using X-light in treating diseases of the outer surface of the body, the source of X-light should be at the wall of the vacuum tube.

In using X-light in treating diseases of the outer surface of the body, the area to be treated should determine the area of the tube wall from which X-light should originate.

In using X-light in treating diseases of the outer surface of the body where the vacuum tube is brought in contact with the skin, the area of the wall of the tube from which X-light arises should be cooled. In using radioactivity, the source of the energy should be in a case from which no radioactivity can escape except in the required direction.

In using radioactivity, the investigator should be protected from the energy.

In using radioactivity in medicine, the beam of energy striking the patient should be the smallest which will cover the area to be examined, photographed or treated.

In using radioactivity in medicine, the distance of the source of energy from the surface of the body through which the energy must pass should vary directly with the distance of the diseased tissue below that surface; the nearer the disease to the surface the nearer the source of energy should be to the surface.

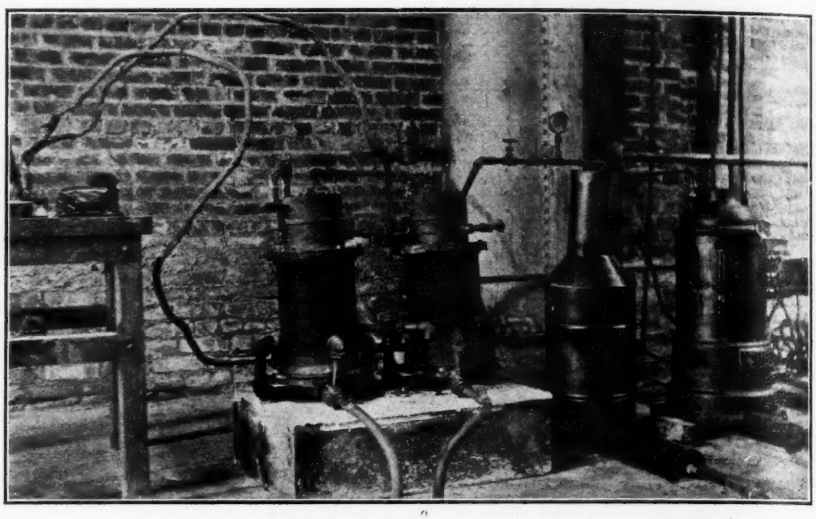
A New Device for Producing Electrical Currents.

On Wednesday, December 2, a demonstration was given at 352 Mulberry street, Newark, N. J., of the "Dynelectron," an apparatus designed by Mr. James H. Reid and his son, Mr. Allen E. Reid, for the direct production of electrical energy from fuel. A gas retort was charged with culm mixed with street sweepings and oil, and heated externally, steam being passed through the retort. The gas thus produced was mixed with air, in the proportion of one volume of gas to forty of air, and was then forced through two cells consisting of cast-iron shells, containing a molten electrolyte and carbon rods. The two cells were connected in series, and upon open circuit gave 1.8 volts; and upon short-circuit through an ammeter, from fifty to sixty amperes flowed. The electrolyte was kept hot by burning gas under the cells.

The construction of the cell will be understood from the following diagram, although the apparatus used in the demonstration differed in certain mechanical details from this. The containing-vessel is of iron, with an insulated cover. From this cover are suspended the carbon electrodes C. These are hollow and porous, and their method of formation is such that the inventor believes they will not disintegrate. Certain of these electrolytes, he says, have been used for about a month, day and night, and show no change whatever, either upon microscopic or chemical examination. Around these electrolytes, and projecting up from the containing-vessel, are perforated iron plates. The cell is filled with an electrolyte consisting of an oxide of calcium, sodium and iron, designated as E in the drawing. The vessel is heated by any means to a temperature of about 390 degrees Fahrenheit, which maintains the electrolyte in a molten condition.

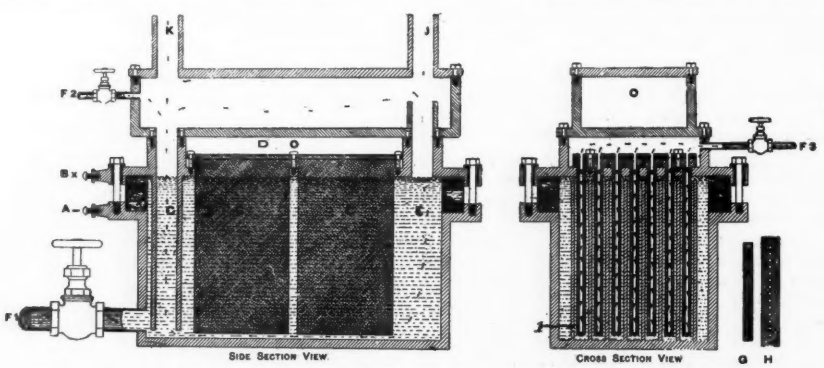
Through the hollow carbons is forced the mixture of combustible gas and air, prepared in any manner whatever. This percolates through the pores of the carbon out into the electrolyte, passes up through this, and escapes through the pipes K J. In its passage through the electrolyte this foams over into the chamber above the cell, and then runs back through the pipe C. It is thus kept constantly in circulation. The electrolyte, it is said, is not affected by the reactions in the cell, and that which was used in the demonstration has been in constant use for experimental purposes for three years.

The demonstration was not intended to prove the efficiency of this process, but merely to show that considerable current could be drawn from these cells. Mr. Reid, however, says that the efficiency of this process is about forty-five per cent. Any fuel can be used, and the flow of gas will be regulated automatically in the completed machines. Mr. Reid is now preparing to build machines for 100 horse-power. These will be eight feet by eight feet by ten feet high, and will generate about ten volts. The cost of a generator of this kind, he says, will not be more than twenty-five per cent of that of an equivalent steam plant. One of the experimental types which was constructed was rated at sixty horse-power. It contained seven cells and gave 6.3 volts. From tests upon this apparatus Mr. Reid was convinced that he was obtaining as electrical energy seventy-two per cent of the energy contained in the gas. This was of poor quality, running about 650 B. T. U. to the cubic foot, and five feet were used per horse-power. This apparatus failed, however, because the carbon electrodes went to pieces quickly, and it required eighteen months of hard work to produce an electrode which would not disintegrate.



A New Apparatus for Producing Electrical Currents.

In the completed design it is intended to return the gases given off from the cell under the cell, and use them for heating it and to assist in producing the gas. When a cell is once put into operation it can be worked continuously for an indefinite length of time, as there is not thought to be any corrosion of the iron vessel or disintegration of the carbon, and no change in the electrolyte.



Side-Section and Cross-Section of New Apparatus for Producing Electrical Currents.

Telephone and Telegraph Construction for the New Republic of Panama.

The director-general of the national telegraph and telephone systems of the republic of Panama is in the market for telegraphic and telephonic material. He would be pleased to receive catalogues descriptive of this material, as the national government is reconstructing the systems throughout the whole country, and would prefer to buy American material. One of the essential elements of the construction in this country is cheap iron poles to carry one or two telegraphic wires. The director would be glad to receive ideas as to costs, weights, etc. Iron poles must be used, because, when the big plains are burned during the summer, the bases of wooden poles burn through. Prices are also asked on telephone cables. The address is: E. T. Leferve, director-general, post office box 290, Panama, Republica de Panama.

CARBIDES.

BY ALEX. A. BEADLE.

The production of metallic carbides in the electric furnace has received much study of late, notably in Germany, where those of all the more ordinary and many of the rarer metals have been produced and their properties studied.

On account of the very high temperature which is required to produce most of the less fusible carbides, the electric furnace has been almost exclusively used for their production, but it would be interesting first to see if any of them has been made by the aid of the ordinary or regenerative combustion furnace.

The regenerative furnace places at our disposal a temperature of about 1,700 degrees to 1,800 degrees centigrade, which for several reasons is not at all likely to be increased by this principle. The oxy-hydrogen regenerating furnace gives us, however, at least another 200 degrees centigrade to make use of on account of the absence of the diluting action of the nitrogen which is here eliminated and for several other reasons. According to Hall, calcium carbide can be produced at a temperature of 1,500 degrees centigrade, which is well within the limits of the regenerative furnace. Bergmann also produces it by means of an ordinary blast furnace, for which purpose he uses a charge of coke and lime, but in the place of air he uses oxygen which, of course, greatly increases the available temperature.

It does not appear that any other carbides can be thus produced, but for this purpose the electric furnace is called into requisition. This, however, places at our disposal probably another 1,500 degrees centigrade, which makes all the difference.

The reactions which take place in the electric furnace when the oxide of a metal is heated with carbon are somewhat more complicated than it would at first appear. It is manifest that the reactions and the final result are to a very large extent influenced by the proportion of the carbon to the oxide in the charge. If, for instance, a charge is introduced into the electric furnace in which there is just sufficient carbon to combine with the oxygen of the metallic oxide to form an equivalent of carbon monoxide and there is no appreciable excess, we should expect a metal as the final product. If, however, we introduce with the charge a large excess of carbon, sufficient to form a carbide, we should expect to find the whole of the metal converted from the form of oxide to that of carbide. This is to a large extent true; thus if manganic oxide be mixed with about eighteen per cent of carbon the metal is reduced, but if the proportion in the body of the charge much exceeds twenty per cent a large proportion of carbide of manganese is produced.

It is not really essential to introduce in the first instance a charge containing the metal to be reduced, or converted into carbide, in the form of oxide, but it may be used as a salt which is itself capable of forming an oxide upon calcination. In this way metallic chromium may be reduced from calcium chromite or chromate or sodium bichromate, titanium from titanite and manganese or molybdenum from a manganate or molybdate.

Almost all the commoner metals and many of the rarer ones are capable of forming carbides in the electric furnace, and although the composition of some of these is somewhat doubtful, many present but little difficulty.

Among the industrial metals the most important carbides are those of aluminum (Al_4C_3), iron (FeC_3), magnesium (MgC_2), manganese (Mn_3C), and tungsten (W_2C). Among the alkali metals are caesium (Cs_2C_2), sodium (Na_2C_2), and potassium (K_2C_2). Among those of the alkali earths, barium (BaC_2), calcium (CaC_2) and strontium (SrC_2). Among the rarer metals and metalloids, boron (BC (Wahl and Green) and BC (Moisson)), cerium (CeC_2), lanthanum (LaC_2), molybdenum (Mo_2C_3), selenium (SeC_2), silicon (SiC "carborundum"), thorium (ThC_2), titanium (TiC), uranium (U_2C_3), and zirconium (ZrC).

There are but few of the properties of metallic carbides which interest the chemist besides the power to decompose water or to withstand oxidation, and in one or two instances, the conducting power and hardness.

Two carbides possess the property of hardness in an extreme degree, carbide of silicon, now called carborundum, the hardness of which lies between 9 and 10, nearer in fact to 10, and also boron carbide (B_6C) which, if anything, is even slightly harder than carborundum. But the latter carbide is obviously the cheaper of the two and, as it is nearly as hard, it is of more commercial value.

With regard to the oxidizing action of water or damp air, five at least can be said to be quite inert at or near the ordinary temperature, namely, those of boron, silicon, titanium and zirconium. Six are strongly acted upon, namely, those of barium, caesium, calcium, lanthanum, thorium and uranium. The rest lie midway between these two classes, being slowly decomposed.

The kind of reaction which takes place when these carbides are decomposed by water or moist air is somewhat complicated, depending upon the valency of the metal, etc. The following examples of reactions may, however, give some idea as to what generally takes place.

Manganese carbide evolves a mixture of methane and hydrogen, according to the equation—

$$MnC + 6H_2O = 3MnOH_2 + CH_4 + H_2$$

Those of the cerium group evolve a mixture of methane and acetylene, thus—

$$3CeC_2 + 6H_2O = 3CeOH_2 + CH_4 + C_2H_2.$$

Thorium and uranium carbides yield in addition to this some hydrogen, while the carbides of calcium, barium and strontium evolve acetylene.

Calcium carbide is used for the production of acetylene in preference to the other carbides on account of the more general occurrence and consequent cheapness of lime, but it appears that barium and strontium would work as well.

A new compound called "siloxicon," very much akin to a carbide but apparently containing some combined oxygen and which has lately been discovered by Mr. E. G. Acheson, may here be mentioned. Its composition is apparently Si_2C_2O. According to Mr. Acheson this body, when heated to about 5,000 degrees Fahrenheit, splits up into carborundum, silicon and carbon monoxide, the vapors of the two latter being driven off. If oxygen is admitted at this temperature or considerably below it the siloxicon simply decomposes or burns into silica and carbonic acid. He also states that under similar conditions carborundum has been found to be oxidizable. This body seems to be a sort of basic or acid carbide, and it will be interesting to see if other metalloids are capable of forming corresponding compounds.

One of the greatest enemies and causes of trouble to any first-class packing is water in cylinders, which, when it occurs, demoralizes the packing. Strange to say, no metallic packing has been designed which will give first-class results as a water packing—the water rods of pumps, for instance. When first applied they usually work with fair success, but soon commence to leak and continue doing so. Also no thoroughly satisfactory packing has been invented and used for expansion joints. There is quite a large field for investigation in this direction.—*Scientific American.*

Telephone Systems and the Fire Hazard.

The Insurance Society of New York held a meeting at the rooms of the Underwriters' Club on Tuesday evening, November 24, at which Mr. C. J. H. Woodbury, of the American Telephone and Telegraph Company, spoke on "The Telephone System."

As would be expected of a paper before that society, the speaker directed the main portion of his theme toward the conditions of the telephone system pertaining to the interests of underwriters. He explained the extent of the telephone plant and the methods of operation, but largely the methods of construction of the buildings and the extreme care which is taken in the management of telephone companies to guarantee the continuity of the service, and these measures were largely those of the prevention of the occurrence of fire which would be one of the more serious damages to such property. On the equipment of the telephone lines with protectors to defend against the whole range of foreign currents, he said that telephone protectors used by the Bell companies, which are especially careful in this regard, are threefold in their nature, the first element consisting of a fuse made of an alloy which is contained in a tube of vulcanized fibre and these fuses will deflagrate when exposed to currents of seven to ten amperes, the capacity of the fuse being varied according to the type of the apparatus.

The next element consists of a pair of small carbon blocks whose larger surface measures about one by one and one-half inches, one of which is connected to the telephone circuit and the corresponding block to the earth and separated by a sheet of mica, a portion of which is cut away so that the surfaces are exposed to each other. A small cavity in one of the opposite faces of the carbon is filled with a button of solder such as is used in automatic sprinklers and which melts at 165 Fahrenheit. The distance between the carbons is such that electricity at over 350 volts will pass from the carbon connected with the telephone circuit across this space to the opposite carbons and thence to earth, thereby relieving the telephonic apparatus of electric tension exceeding 350 volts; thus, if the foreign current exceeds the carrying capacity of the tubular fuse its deflagration opens the circuit at that point. If, however, it is less in volume than the carrying capacity of the fuse and over 350 volts tension, it leaps across the thin space separating the carbons and thence passes to earth. The resistance of the tiny arc in the space between the carbons is sufficient to warm them and cause the fusible metal to flow from its recess and fill the space between the carbons and thus establish a conductor of low resistance to earth. This diminished resistance generally causes a sufficient increase in the foreign current imposed upon a line to cause the tubular fuse to deflagrate and open the circuit if it did not do so on the first occurrence of the contact which imposed the foreign circuit on the telephone circuit.

In order to protect the fine wires of the telephone apparatus from injury by currents which are too small to operate the tubular fuse and of too low tension to pass to earth through the carbon cutouts a third element, known as the heat coil, is employed which is a fine German silver wire and which forms a part of the telephone circuit and is heated by a current of one-sixth of an ampere to a temperature sufficient to release a conductor ordinarily secured by fusible solder and pass the current to earth. This latter element of the device is not used at the subscriber's end of the line in these modern types of telephone apparatus in which the circuit is normally open except when the telephone is in use. The result of this protective apparatus has been so successful as to establish conditions of immunity in the Bell system of telephony against mishaps to the apparatus resulting from foreign currents and lighting throughout an experience of many years.

Every possible precaution must be taken to avoid contact between high-tension and signaling lines and prevent the occurrence rather than to rely upon protective devices to defend the plant against physical injury, because the operation of a protector suspends the service over that line for the time being. At crossovers it is preferable that the high-tension line should be above, as its wires are of larger diameter and generally fewer in number. The simplest method to prevent contact in such positions is to make the upper span so short that the radial distance from the lowest wire of the upper span to the nearest wire in the lower span is less than the width of the upper span and then to dead end wires to prevent overhauling in case of breakage occurring on adjacent spans. In many instances this method of line construction is unfeasible because the poles for such a short upper span would interfere with the requirements of travel in the highway and other methods of preventing contact in case of breakage must be adopted, usually by guard wires which in some instances are connected by slats secured transversely across them. When different lines are parallel to each other the distance between them should be so great that the highway lines could not touch the wire of the lower line if it fell toward it. In all cases when high-tension and signaling wires approach each other every precaution should be taken to prevent against possible contact by the use of heavy material in construction and guys and braces to the poles as may be needed to assure their stability.

Placing wires underground appears to have eliminated all of the hazards, if the ordinary principles of construction of refraining from placing high-tension and signaling wires in adjacent conduits are observed.

He corrected the general opinion of the damagability of the switchboard by water stating that although the switchboard was sensitive to water and must be absolutely dry for successful operation, yet they have been dried out after being wet and that in such respects are no exception to many other classes of contents of buildings, and that the facts are far different from the newspaper item which was quoted to the effect that a tumbler of water would cause a thousand dollars damage on a switchboard.

Of the advantages to the underwriters of the private branch exchange system, now generally in vogue in large establishments, was mentioned the fundamental difference being that whatever fire hazard existed to a telephone without considering the question of protectors was proportionate to the exposure of the line wires to the wires of other currents, and if these wires could be reduced in number, as is the case with a private branch exchange, the fundamental hazard is diminished in like ratio; furthermore, it is an advantage to have the wires under skilled supervision as they are in such instances, especially in case of emergency calls and especially in cases of fire, because if one circuit is out of order another one can be used. The buildings erected by the telephone companies are of fireproof construction, especially designed for the purpose, with a view to obtaining stability under heavy loads and to afford resistance by fire. They are equipped with subsidiary fire apparatus, and windows opening toward exposures are provided with fire shutters. In smaller towns, where special telephone buildings are not warranted, every endeavor is made to obtain quarters in the best building possible in order that the permanency of the station may not be interfered with by the general fire hazard. The telephone property is under constant supervision of the most systematic manner, in addition to the constant occupancy by the operators who can reach the fire department at any time.

Many details were given by the speaker of elements of the telephone system in order to set before the audience the wide scope of its applications to every-day life and the absolute necessity of taking every possible precaution for the permanency of the service.

The Finzi Single-Phase, Alternating-Current Traction Motor.

By Enrico Bignami.

THE single-phase alternating-current traction motor recently designed and tested at Milan, Italy, by Dr. G. Finzi, is the natural adaptation of the marine type of continuous-current motor made by the Brioschi-Finzi Company. This motor has been the standard type for auxiliary uses on board of the Italian men-of-war, and its characteristics are laminated multipolar field core, with longitudinally divided poles, a small air-gap and low speed, and, lastly, a set of resistances connecting the inductor windings through the commutator sections.

The longitudinal division of the poles, as often suggested and sometimes used, is fully as important as the laminating of the field, and stands as the simplest means of killing the reaction flux of the armature.

The single-phase traction motor designed by Dr. Georgi Finzi was first of all accurately tested in the testing room of the Gadda Brioschi-Finzi shop. Out of the results, the characteristic curves of the motor were drawn (Figs. 1 and 2). Fig. 1 shows for each voltage applied, the amperes in function of the angular speed (full lines) and of the torque (dotted lines).

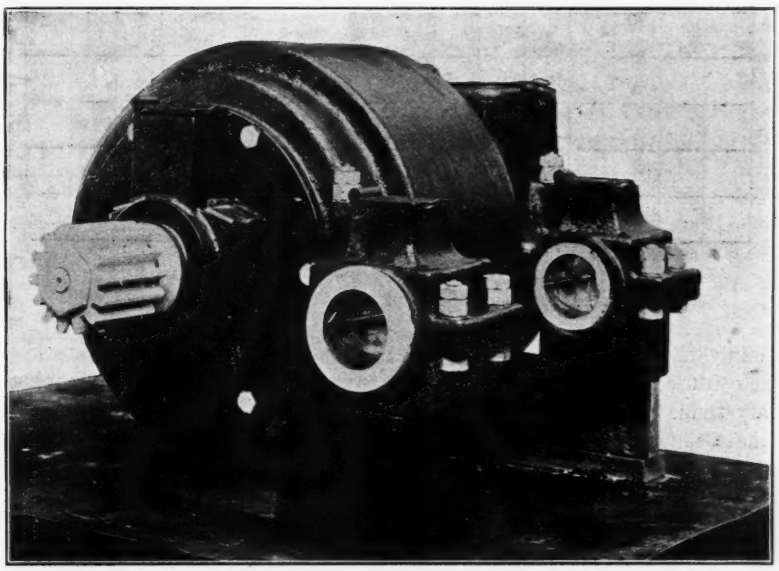
In this case the curves allow the clear statement that for a given torque the current is slightly higher with a higher voltage, and this more clearly when the torque be greater. Thus there are a number of slightly divergent torque-current curves.

Fig. 2 gives the efficiency and the power-factor for this particular motor for various voltages in function of the speed. It is interesting to note that in the efficiency curves the higher segment corresponds to lower speeds when the voltage is lower, so that even though the efficiencies be not particularly high, the motor always works in favorable conditions, its speed being generally lower when the voltage is kept lower. Attention is called to the high level of the power-factor whenever the speed be above the lowest figures.

This motor was geared to one of the ordinary cars that the Edison company uses for city service; there were taken off the continuous-current motor (0.7) ton, one controller (0.072 ton), the rheostats (0.08 ton). Given 6.7 tons for the fully equipped car, the stripped car remains at 5.85 tons. There were then put in place the single-phase motor (0.8 ton) and the controlling transformer (6.5 ton), bringing the weight up to 7.15 tons. To save time a standard forty-kilowatt transformer was used for controlling, while a fourteen-kilowatt one is sufficient with a weight of 0.25 ton, giving a total weight of 6.85 tons for the equipped car.

The circuits on the car are shown in Fig. 3. The line from the trolley has a switch I_1 on one platform; then it passes to the other where the controller is placed, and passes an ammeter A_1, a snap-fuse V and another switch I″, then the autotransformer; the other end of this is earthed, and so is one brush of the motor. The other brush goes to the field E″ and then to the handle of a controller, which takes current from different points of the transformer winding. These points go to five sections, corresponding to 80-100-120-140 volts, giving a 500-volt supply and the passing of the five points was successfully made, absolutely non-sparking. It is seen that the five points were running points. For stopping either of the two switches I_1 or I_2 was opened. This was only for simplicity's sake, because generally use was made of already existing pieces of apparatus. Of course, the controller as designed for practice has a dead section for stopping. Through a commutator C the fields were inverted to run in the opposite direction; an ammeter A″ showed the current in the motor, and a voltmeter V the voltage. All testing instruments in the cars were of the hot-wire pattern. A special circuit, wired as usual from trolley to earth, carried the incandescent lamps of the car.

The usual way of gearing the motor was adopted. A standard pinion (fourteen teeth) geared to a sixty-seven-tooth wheel (4.78 ratio). The diameter of the car wheels was seventy-seven centimetres. A Kapp accelerimeter was fastened to the car; while for measuring the speed several methods were used, the ultimate and most exact one being to get it indirectly from current and voltage through the well attested curves of the motor itself.



FINZI ALTERNATING-CURRENT, SINGLE-PHASE TRACTION MOTOR.

The generating station had its place near the laboratory of the Edison company, in its works at Porta Volta, and contained a sixty-horse-power, 3,600-volt, three-phase induction motor, belted to an old eight-pole alternator with rotating armature that gave a frequency of eighteen at 270 revolutions. The exciter was one of the very old curious Edison dynamos with thin upright fields.

The voltage from the alternator was raised from ninety to about 550 by an autotransformer, feeding the trolley line through the laboratory, the other wire being connected to the rails. The instruments were: a hot-wire ammeter, a Thomson integrating wattmeter and a Siemens wattmeter, which was replaced after some nights by one of the excellent recording wattmeters of Olivetti's, specially ar-

ranged for these experiments. Another voltmeter showed the line voltage; this varied from 575 at open circuit to about 520 when the car was running.

The greatest number of runs was made during the night on the municipal line

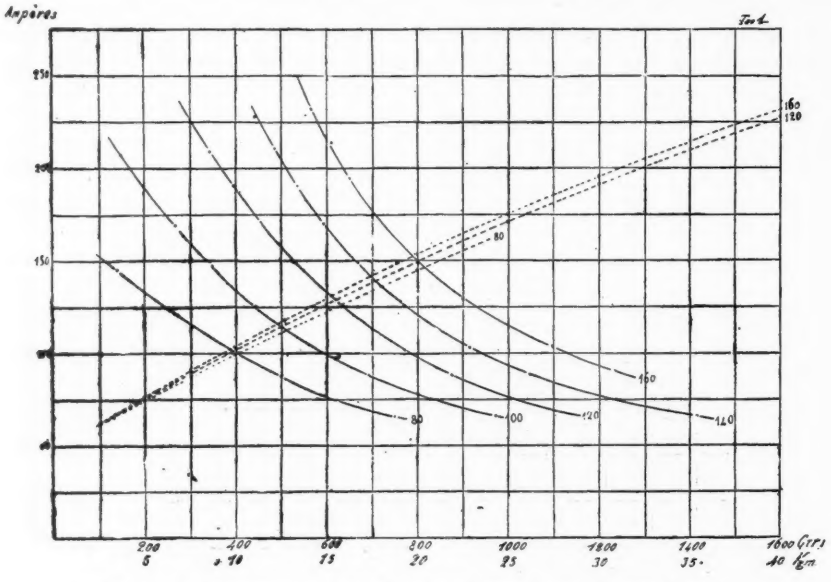


FIG. 1.—CHARACTERISTIC CURVES OF THE FINZI SINGLE-PHASE MOTOR.

connecting the Monumental Cemetery to the new Musocco Cemetery; when the ordinary traffic was stopped the Musocco and the Cagnola sections were disconnected from the continuous-current system and the alternating current was fed in. The track had Vignole rails for its whole length—about five kilometres—with a considerable number of switches and several curves of a small radius; the crossing with the ordinary circle railway has an average twenty-five per cent grade for 225 metres on each side. Besides, the whole line has an average grade of two per cent from Musocco to the Monumental Cemetery.

The test runs began on June 29, 1903, continuing for ten nights; the two last nights' runs were made through the whole town of Milan, running on the tram-car lines (Phœnix rails) with a trailer, through Bramante-Principe Umberto Vincenzo Monti-Monforte and nearly the outer circle complete. The total mileage of the car was about 200 kilometres. Not the slightest difficulty was found from such new electric equipment, and it is remarkable that even the grade and curve of the Central Railway station was managed, though not very easily, by the car with full load and one trailer, while, owing to the drop of voltage of the generator, the motor received only ninety-five instead of 160 volts.

The first tests showed very smooth speeding up, and the same absence from sparking that the laboratory tests had shown; this satisfactory commutation being chiefly apparent in starting, when the motor by all means behaves better than the corresponding continuous-current traction motor. Some little sparking occurs from time to time, only when the full voltage is fed; not more, however, than usually observed in a good standard traction motor. The infrequent sparks did not show the color or the light of an arc, resembling rather carbon particles worn away from the brushes. As a matter of fact the 200 kilometres left the commutator perfectly clean and smooth, with the same appearance it showed before, and the brushes suffered no measurable wear.

The car was lighted with the same lamps that were on the ordinary 500-volt circuit; six incandescent lamps in series. The slightly higher alternating voltages made them burn more brightly than usual and the fluctuations of the current were not much felt; they would disappear altogether by the use of standard lamps of fifty volts or less, instead of the 100 volt ones.

The object of the test was, on one side, to determine the general working of the motor in regard to its specific qualities for traction use; on the other, to measure how much power the runs and the startings absorb, in comparison with standard continuous-current equipments. With these objects the runs have been of two different classes; some were occupied with instantaneous readings of the instruments and together with the diagrams from the Olivetti wattmeter gave the power necessary to keep up the various speeds when once attained; these runs had very few startings, in fact only those that were necessary.

Other runs were full of successive speeding up and stopping; thus there was gathered an exact idea of what a standard starting was, while the figure from the integrating wattmeter at the end of the run showed the difference due to a given number of startings in comparison with the energy absorbed by a run without startings.

The result does not claim a very high degree of accuracy; in fact no traction experiments can, owing to the difficulty of getting exact readings at the same moment, and to the complex elements of the experiment; they are, however, trustworthy so far as they go, and some results

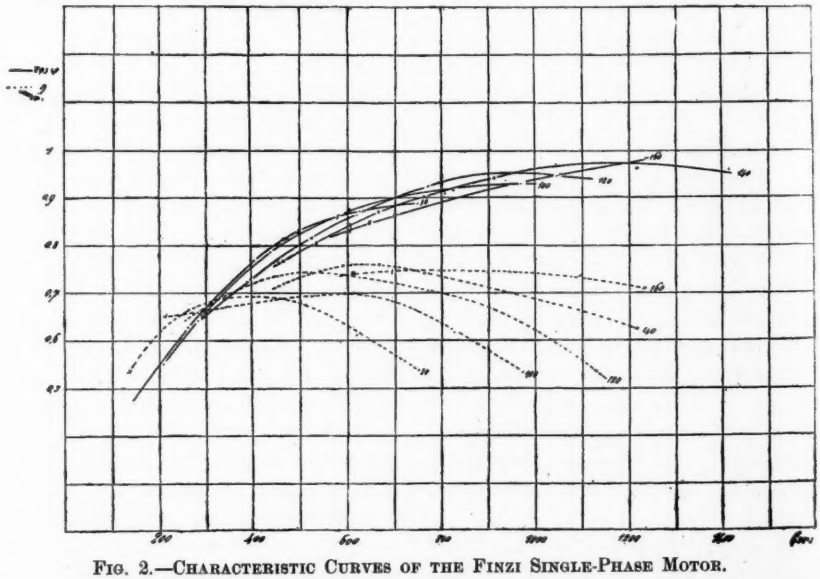


FIG. 2.—CHARACTERISTIC CURVES OF THE FINZI SINGLE-PHASE MOTOR.

when arrived at through different paths show satisfactory concordance.

In Fig. 4 the line A shows the power at the generating station that is necessary for a ten-ton mono-phase car, on a level straight track, at speeds between twenty-five and forty kilometres per hour. This curve is average from all our experiments, and it is the collective result of the Siemens wattmeter readings at measured speeds and of the Olivetti diagrams. The experimental points are rather dispersed, but not more than we anticipated from having a track with many grades and with short straight segments where a speed could only be kept up a short time.

The B line shows the power given by the motor, and it is obtained from A, taking account of the line loss, the transformer loss, and the efficiency of the motor giving the voltage and the speed.

The line C gives the energy in watt-hours per ten-ton car-kilometre given by the motor; line D gives the energy dissipated per car-kilometre in mechanical friction, that is after subtracting the air resistance. This last was computed, considering the shape of the car and taking advantage of the coefficients found in the latest experiments (Finzi and Soldati on air resistance). Thus we find that mechanical friction absorbs ten watthours per ton-kilometre, of which about 0.5 is gear friction; this leads to a traction coefficient of 3.48 kilogrammes per ton, a very normal figure for a level straight track and for Vignole rails.

A comparison has been made between a single-phase motor acceleration and a continuous-current motor acceleration. A number of runs were made to secure accurate data for acceleration and energy output. These were made, some in one and some in the opposite direction, to eliminate the influence of the average two per cent grade on the line over which the runs were made.

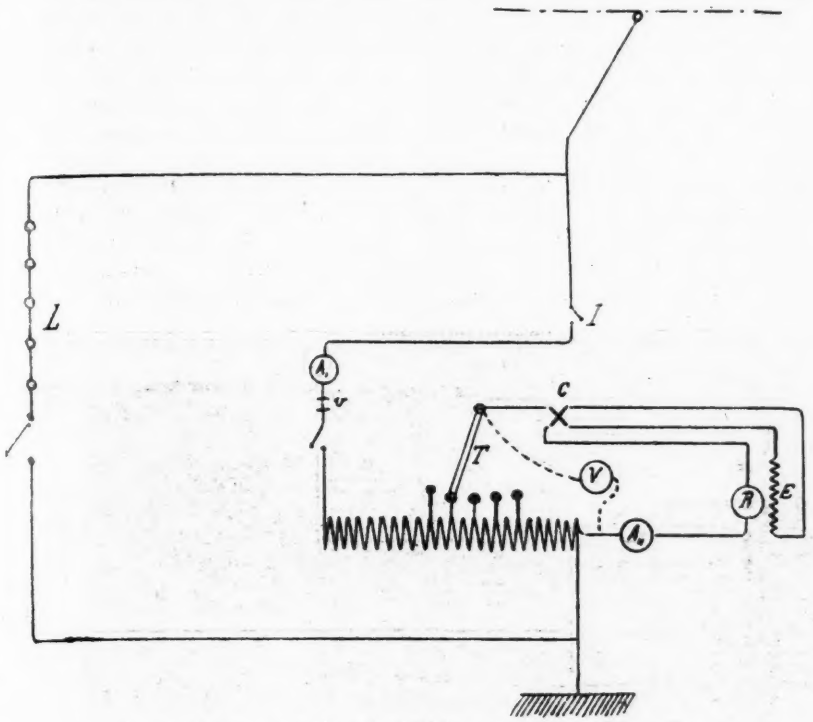


FIG. 3.—CIRCUITS ON CAR USED IN TESTING FINZI SINGLE-PHASE MOTOR.

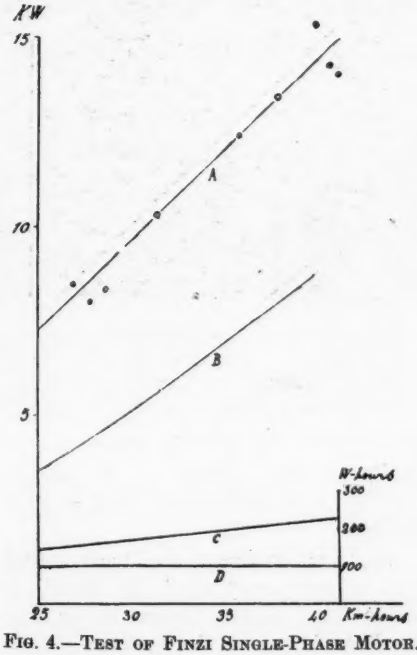


FIG. 4.—TEST OF FINZI SINGLE-PHASE MOTOR.

On a town tram-car system a maximum speed of twenty-two kilometres per hour was necessary between successive stops, to get an average speed of seventeen kilometres per hour. There was thus attained a speed of twenty-two kilometres per hour on an average acceleration of 0.25 metre per second with a single-phase motor. Even at starting, a low absorbed power was found, though the efficiency of the motor is a trifle lower than it should be, on account of the resistances which the motor still had in series with it. Integrating the power curves of the motor to twenty-two kilometres speed, this was found to be 9.4 watthours per ton. Integrating to a 23.5-kilometre speed, the single-phase motor showed 10.6 watthours per ton.

The theoretical amount of energy for starting to the twenty-two-kilometre speed would be 6.6 watthours per ton.

The experiments showed that the mono-phase motor would allow a wide range of velocities without lowering the efficiency at normal speed. The power-factor varies between rather wide limits, according to the speed and voltage, as the characteristic curves of the motor (Fig. 2) show. Making a comparison of the wattmeter diagrams with the instantaneous current and voltage figures at the station during the run, it was found that the average power-factor (for line transformer motor) was 0.8, varying between limits of 0.6 and 0.95.

A New Process for Electrogalvanizing.

A new process for electrogalvanizing has just been discovered by Ignaz Szirmay, of Budapest, Austria, consisting essentially of adding grape sugar (dextrose) to a bath, and he says that a pure, glossy deposit of zinc is obtained, free from blisters and adhering so tenaciously that the object may be bent without the coating peeling off.

His method is as follows, *viz.*, twenty-eight pounds of sulphate of zinc are dissolved in twenty-five gallons of water, preferably warm. Next dissolve separately in boiling water, one and one-half pounds of sulphate of aluminum, twelve ounces of sulphate of magnesium (Epsom salts) and six and one-half pounds of grape sugar. These solutions are then added to the sulphate of zinc solution. The resulting solution should be clear and have a feeble acid reaction. An anode of pure rolled zinc is recommended. The deposition is carried out at about sixty-five degrees Fahrenheit, with a current of ten amperes per square foot, and a voltage of four volts. In order to prevent bubbles of hydrogen gas from adhering to the work it is kept in motion. This also serves to stir up the solution and keep it uniform.—*Metal Industry.*

Electricity in Siberia.

By an American Traveler.

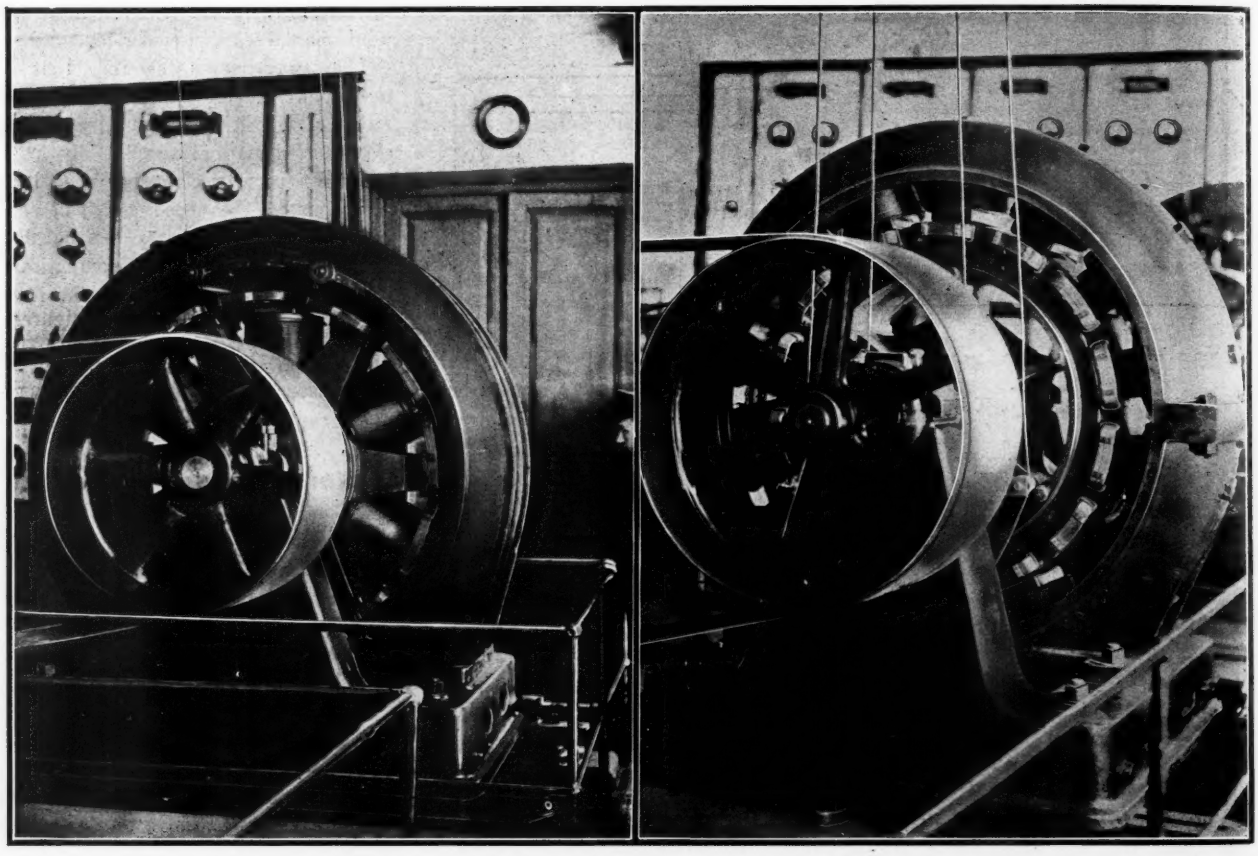
THE subject of electricity in Siberia, it is believed, has never been reviewed in any journal at length. During two years' travel over Siberia and Russia, taking the westward route from the Pacific Ocean overland to Europe, the writer saw practically all of what was to be seen of an electrical nature in the far north. Hence the authority for the present article.

Central stations are located at Omsk, Tomsk, Krasnoiarsk, Irkutsk, Blagovechensk and Vladivostok. This last is on the Pacific. The first town is hundreds of miles beyond the Asiatic versant of the Ural range.

The central station at Tomsk is the best equipped, and was entirely installed by Brown, Boveri Company, Baden, Helvetia. This station is owned by the municipality, and is like any other installation in Europe equipped by the same company—affording very little novelty, save in the fuel, which was all wood. The great forests of Siberia made the fuel problem safe for a few years, until the advent of the trans-Asiatic railroad, when fuel for the locomotives and for the millions of ties which were used for the permanent way, began to make a serious drain on the adjacent country. At Tomsk at the present time, liquid fuel is brought from the Baku-Batym district in meridional Russia, *via* the Volga and the central Ural, and stored at the Tomsk central station.

Over a year ago the writer made three efforts to secure views of this station, together with relative data on the working cost and output. These resulted in failure, however—even the chief who pointed out the features of the station failing to reply to questions of this nature. The accompanying pnotographs have been secured since the writer's return to the United States. Siberia is the hardest country in the world from which to get a reply.

The steam engines at the Tomsk central station were constructed by Bromli & Company, of Moskba, Central Russia. The flywheel diameter is three metres, normal running 140 revolutions per minute, and the nominal horse-power is 125, with a maximum of 150. These engines are belt-connected with three dynamos. The dynamos were built by Brown, Boveri & Company, of Baden, Switzerland. These are rated at 400 revolutions per minute, 2,000 volts. The four boilers were built by Bari, of Moskba, following the system of the Russian engineer Chyxof. Three of these boilers have 740 square feet of heating surface, and the other 1,145 square feet, and they work at a pressure of 150 pounds. The vertical compound engines are on Wolf's system, developing 225 horse-power at 225 revolutions per minute. The cylinders are sixteen and twenty-six by fourteen inches, and are all provided with condensers. The maximum electrical output is 2,500 kilowatt-hours per day.

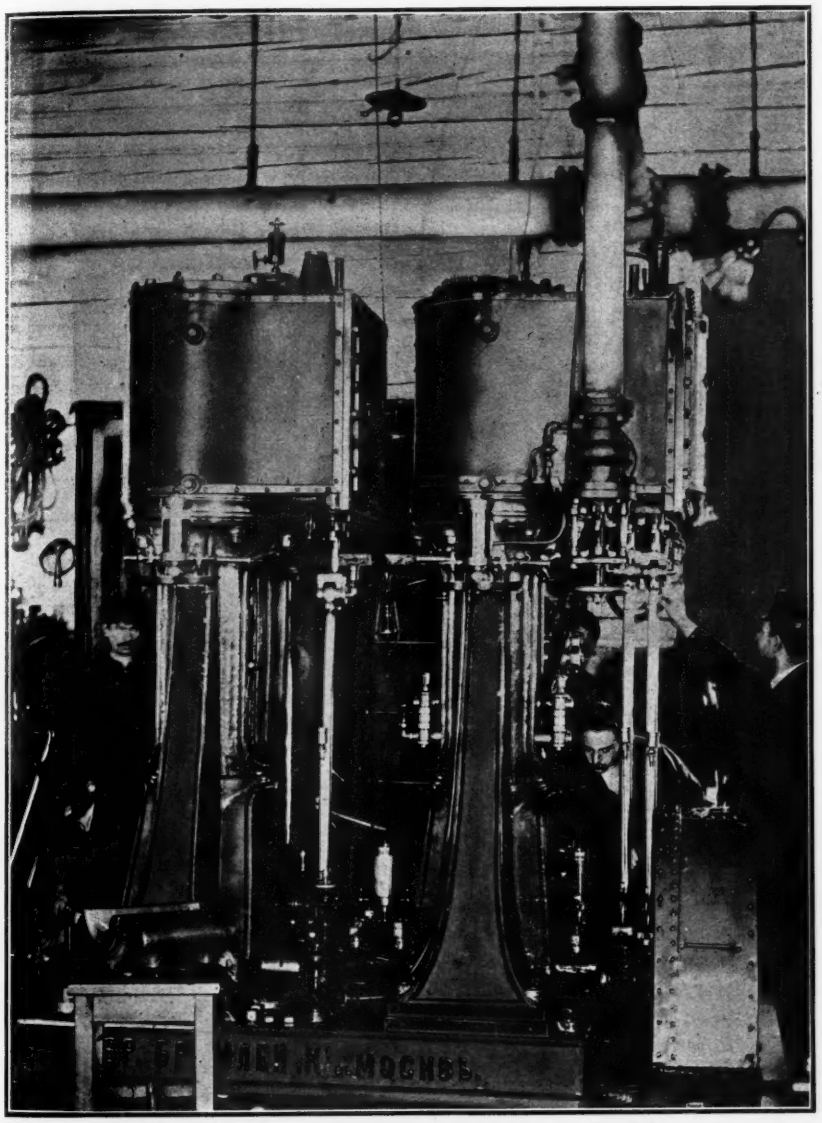


VIEWS IN THE DYNAMO ROOM, TOMSK CENTRAL STATION, SIBERIAN RUSSIA.

While there is nothing to learn from Siberian electrical engineering, there is something Americans can learn as to Siberian electrical needs. Their trade is worth having.

The status of the electrician in Siberia is not enviable. A central station employé (a practical mechanic) will work eleven hours a day and receive abouty eighty rubles monthly. This is equal to $40 in United States coin, but its purchasing power will only be what $30 would be in

America. In this way he just exists. The pay of a station chief is little better—about 100 to 120 rubles per month. It is true that free lodging is thrown in with the above wages, but still this is not calculated to induce many to seek occupation in Siberia. Telegraph operators receive about sixty rubles per month, and have to find everything from housing to uniforms. They work in twenty-four-hour shifts, then forty-eight hours off.



One of the Vertical Engines, Tomsk Central Station, Siberia.

The periodical electrical literature received by Siberian central station employés is largely German. Some of the chiefs subscribe to three or four Paris journals of their profession. The writer never saw a single current British electrical journal in the whole of the land, and only at Vladivostok a couple of stray copies of a long-since-defunct London monthly called *Electrical Plant*. Of American journals a few copies were seen here and there of the *Telegraph Age* (received by employés of the overland telegraph) and the Electrical Review. This latter paper was all the writer had to remind him of electrical engineering in the United States during a couple of years wandering hither and thither over Russian Asia, with, in some instances, its villages three and four hundred miles apart.

The only product of an electrical nature made in the United States that he saw throughout the whole of Siberia was some insulating hard-fibre sheeting coming from a firm at Wilmington, Del. A quantity had been imported *via* San Francisco and Vladivostok. The report on it was excellent under normal conditions of temperature, but under prolonged freezing at minus thirty-five to minus forty degrees during the winter months, it became as brittle as slate. The writer saw the effect of a shock on a piece of this insulation as it lay in the yard in the Arctic cold. When struck, it shivered with a perfectly clear fracture into three or four pieces, just like a piece of slate; but the fracture was confined to the region where struck. In normal weather the same material was almost as non-liable to fracture as leather.

Although passing a couple of winters in the far north, and often out late at night on the steppes, the writer never had the opportunity of witnessing the electrical phenomenon of aurora borealis, in spite of always being on the lookout for it. The route of the Trans-Siberian Railroad, which was under construction at the time the writer was in Siberia, and which he followed, is a couple of thousand miles too far south for the observation of this phenomenon. Engineers along the line informed him it was to be seen occasionally, however, even on that parallel, during intensely cold, dry spells.

Some fifty private concerns in the different Siberian towns have small electric lighting plants of their own. They were mostly put in before the central station of municipal plants were in being. The best private plant noticed was that of the importing firm of Kunst & Albers, at Vladivostok. This company started in a comparatively small way, and has grown to considerable dimensions. Being a Dutch concern, of course all of its imports are from German quarters. Its dynamo room is fitted up very nicely, and operated at a good efficiency. All of the material, and also the personnel, are Dutch. Commercial concerns in Kabarofsk, Blagovechensk, Chita, Ctretensk, Verçni-Udinsk, Irkutsk, Krasnoiarsk, Tomsk, Omsk and Ekaterinbypr also have their own private lighting plants, as well as a couple of the opera houses.

There is quite a number of mines worked in Siberia, and a few of these have electric lighting plants. The mines, however, to the extent of about ninety-seven per cent, do not pay, and are being abandoned, as foreign investors are slowly coming to realize that these are not a profitable proposition. Many large factories—as, for instances, cement works, woodworking plants, iron founderies, etc.—have installed plants and are using considerable electricity.

All of this betokens that affairs electrical are looking up in Siberia. This is a fact, and so far the Germans, Austrians, Belgians and French have had this market entirely to themselves. Even commercial England has not secured a foothold in electrical Siberia—or what there is of it. The writer saw nothing moving

that was a British electrical equipment anywhere between the Pacific Ocean and the Ural range. Notwithstanding this, the British have a special agent in the heart of Siberia, at Krasnoiarsk. This agent carries a representative British hardware line, but little or no electrical apparatus.

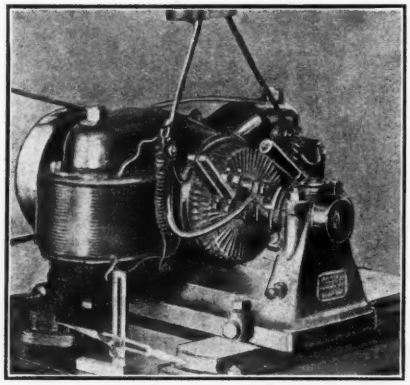
It is evident, contrary to the general belief, that electricity is already a permanent factor in Siberia. The reason for its development in Siberia is easy to see. Illumination better than that given by the kerosene lamp is wanted by the large concerns in the towns and in the country. Gas is out of the question, as there is not a gasworks in the whole of Siberian Asia, so the advantage of the gas mantle could not be used by them. Therefore it has been resolved that if any improved lighting were to be introduced, recourse must be had to electricity.

In order to capture Siberian trade, the ordinary illustrated catalogues should be sent there, and will be understood by all. Illustrations are especially necessary. These catalogues may be sent by post to applicants or to leading electrical people and importing hardware firms throughout Siberia. Price lists should go with the catalogues, or the advantage will be lost. "Prices on application" will hardly do with a far-away country like Siberia. These catalogues are carefully preserved throughout that country. There is no need of going to the great expense of having catalogues printed in the Russian language.

One important condition to which the writer would call the American manufacturer's attention, is business on an absolutely cash basis. The Continental electrical firms give long credit—sometimes as much as two, three or five years—and most of them have a hard time trying to collect at that. A poor-paying customer is not worth having. However, there are, in Siberia, a number of cash-paying concerns whose liberal orders are worth the booking.

The Siberians have electric lighting, and very little else of an electrical nature. True, the telephone is found in all of the towns, and for most of the distance along the Trans-Siberian Railroad, but the luxuries—for instance, electric heaters, cooking conveniences, stoves, curling irons, portable lamps, and a host of other articles—have never been seen there. The writer did not see a dry battery throughout the land. Even the medical practitioners use the wet battery for their tiny examination lamps and apparatus. The physicians know through the journals of the X-rays, but it is doubtful if there is a Crookes tube in the country. It is possible, however, that in recent months one of the Siberian colleges has installed a static machine or a radiographic apparatus.

The short Siberian summer is of tropical warmth, and officials and civilians take to white clothing to minimize the discomfort caused by heat. During this period it is comfortable to sleep out of doors at nights to escape the heat of the rooms. In spite of the great heat, in not one of the towns provided with a central station—and consequently having the proper power at hand—was there observed



A Much-Used Siberian Dynamo, Tomsk' Central Station.

a solitary electric fan. It is the writer's opinion, however, that a few well-distributed American catalogues and the advertisements of the Electrical Review will have changed this before long.

L.

New York, December 5.

Electric Convection.

It follows from the views of Faraday and Maxwell that a charge of electricity, when in motion, produces a magnetic field in its neighborhood. This is the effect on which the modern electron theory rests, and its experimental verification is vital to this theory and to the whole of the recent views on the origin of electric and magnetic forces. A method of testing this was suggested by Maxwell, it first being put to test by Rowland in 1876. This proved to the satisfaction of Helmholtz and of Maxwell that the effect existed. Lecher attempted to repeat these experiments, but with negative results, though they were repeated by Rowland and Hutchinson with results which appeared to verify Rowland's original work. In 1897 Crémieu began some very careful experiments, but in all cases with negative results. Several ingenious modifications of his apparatus gave the same results. Pender, working under Rowland, adopted Crémieu's method, and again verified Rowland's result. Pender was then invited to Paris to repeat the experiment in conjunction with Crémieu, and their conclusions are given in this article. Pender verified Maxwell's theory, and Crémieu disproved it. Repeating the experiment by Rowland's method convinced Crémieu, but did not account for his previous failures. However, in all cases he had covered the charged conducting surface with a thin layer of some dielectric other than air, usually india-rubber or mica, and his failure was attributed to this; for, upon removing the dielectric coating, the convection effect was observed, while on coating the discs used by Pender, the convection effect was reduced ninety per cent. This work seems to close the discussion satisfactorily, but the action of the dielectric coating remains to be explained.—*Nature, November* 12.

Switching for Accumulator Plants.

In small installations making use of storage batteries, it is often desirable to be able to charge a battery with the generator at normal voltage, and the usual method is to divide the battery into two sections, connecting them in parallel, and absorb the excess voltage of the generator by means of a rheostat. This rheostat absorbs about thirty-five per cent of the energy supplied by the dynamo to charge the batteries. To reduce this loss, Herr Ernst Pöhler splits the battery into three sections and charges, by throwing two sections in parallel, the two being in series with the third section, the loss being only thirteen per cent. This arrangement may be carried out by means of one single-pole double-throw and one double-pole double-throw switch, or by means of a three-armed nine-contact rotating switch, which he has devised for this purpose. While charging the arrangement of one section in series with two sections in parallel is maintained until the single section is fully charged. It is then cut out and the other two sections, which have received half charge, are thrown in series, and the charge completed.

A Device for Preventing the Derailment of Cars.

A device for preventing a derailed car from leaving the roadbed has been devised by Mr. Ernst Schott. This consists of a beam, properly supported from the truck and extending beyond the wheels. This is provided with two projections on its lower surface. Should the wheels leave the rail, the car drops down until this beam rests upon the rails. The projections engage with the rail head and prevent the beam from leaving the rail. The car then slips along this beam until it is brought to rest.

SHOP TESTING OF MOTORS AND GENERATORS FOR COMMERCIAL SERVICE—VII.

BY BERTRAND B. ABRY.

VI—ROTARY CONVERTERS.

The previous article on alternating-current generator tests covers those tests which apply in general to rotary converters, but there are some points in connection with the application of certain of these tests to rotaries which we wish to refer to here. It is desired to call attention to the following:

1. Iron loss and saturation test.
2. Short-circuit test.
3. Starting motor test.
4. Temperature test.

Before making any of the above tests it is usually customary to run the rotary with normal field charge for a few minutes to discover, if present, any errors in the assembly of the machine; and further, to test the ratio of the alternating-current and direct-current voltages, which if not correct will indicate, in all probability, wrong connections.

1. Iron Loss and Saturation Test—As in the case of iron loss and saturation tests on direct-current machines, the rotary is driven empty, at a constant speed, by means of a shunt motor. The connections and wiring of such a test have already been explained. In making this test there is a point of difference that should be noted as compared with a similar test on a direct-current generator or an alternating-current generator, and that is that both the alternating-current and direct-current voltages are observed for each change in the field current. When the results are plotted, we have at once then the relation between the saturation and the direct-current and alternating-current voltages at the normal speed of the machine. Care should be taken in making this test to see that the direct-current brushes are set on the no-load neutral point, otherwise local currents will be generated in the brushes, which will have the effect of increasing the iron loss. During the test the following observations are made:

Motor.			Rotary.			
Volts.	Amperes.	Field Amperes.	Speed.	Direct-current Volts.	Alternating-current Volts.	Field Amperes.

In the article on direct-current generators it was explained how we calculate, from the motor input, the iron loss and the friction and windage losses. In the case of rotary converters it is necessary to determine both the alternating-current and direct-current brush friction loss as well as the bearing friction and windage and iron losses.

Let us assume that we have made an

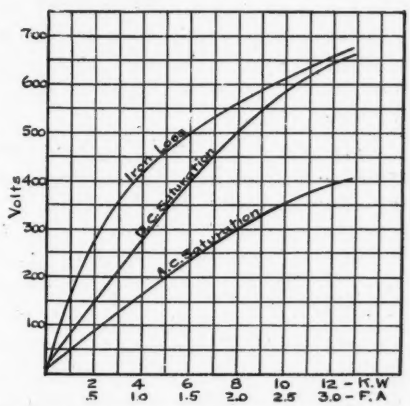


FIG. 20.—IRON LOSS AND SATURATION CURVES. THREE-PHASE ROTARY.

iron loss and saturation test on a rotary converter, and have recorded our observations in some such manner as indicated in the above table. From the motor volts and amperes, we may calculate the motor input, or, as we will call it, motor watts. Knowing the watts input required to operate the rotary with zero field charge and any positive field charge, we may at once determine the iron loss, which loss has been referred to before in previous articles as the "watts lost." Below are given some figures calculated from an iron loss and saturation test which will illustrate this, and also show how the friction and windage losses are determined.

Rotary.				
Motor Watts.	Watts Lost.	Direct-Current Volts.	Alternating-Current Volts.	Field Amperes.
11830	.....	.....	.....	0
12250	420	51	30	3.96
12600	770	92	55	7.32
13600	1770	119	73	9.30
11830	.....	.....	.....	0
14400	2570	160	96	12.75
15800	3970	199	120	19.00
17500	5670	242	145	20.00
11830	.....	.....	.....	0
20180	8350	284	170	24.35
21300	9470	301	180	26.40
23100	11270	320	191	28.90
25200	13370	342	204	32.00
11830	.....	.....	.....	0
8516	3314		Direct-current brushes up. Direct-current brush friction loss.	
7963	553		Direct-current and alternating-current brushes up. Alternating-current brush friction loss.	
2577	5386		Driving belt off. Bearing friction and windage loss.	

After making the last check-reading to obtain the motor watts with zero field charge on the rotary, which is done ever so often throughout the test in order to determine whether the conditions started with are remaining the same or not, the direct-current brushes are raised free from the commutator. Then, still keeping the speed of the rotary constant and the field charge zero, the motor input is again measured. We will assume that this is equal to 8,516 watts, as given above. The difference between the check-reading of 11,830 watts and 8,516 watts, or 3,314 watts, is therefore equivalent to the direct-current brush friction loss.

Next the alternating-current brushes are raised free from the collector rings, and the motor volts and amperes noted, the motor input being 7,963 watts under these conditions. The alternating-current brush friction loss is equivalent then to the difference between 8,516 watts as previously noted, and 7,963 watts, or 553 watts.

After obtaining the brush friction, we may determine the bearing friction and windage by removing the driving belt, and noting the motor input running without load, which is given in this case as 2,577 watts. The bearing friction and windage losses are equivalent then to the difference between the motor input of 7,963 watts and 2,577 watts, or 5,386 watts.

From the result of such a test, the iron loss and saturation curves for the rotary are plotted as shown in Fig. 20. These are given as typical curves of a three-phase rotary.

2. Short-Circuit Test—The short-circuit test on a rotary converter is made on the alternating-current end and is conducted in the same manner as the corresponding test for alternating-current generators. The rotary is driven at a constant speed by the shunt motor employed in the iron loss test, and after the speed is adjusted three sets of readings are taken; first, with zero field charge; second, with a field current giving approximately one-half full load current; and third, with a field charge

giving short-circuit current equivalent to normal full load output. As in the case of the generator test this gives three points on the copper loss curve, which is of the same general shape as shown in Fig. 16.

3. Starting-Motor Test—Some rotary converters as manufactured to-day are provided with a polyphase starting motor, the secondary of which is pressed on the shaft of the rotary itself, and the primary is supported on a bracket projecting from the side of the rotary frame. Before throwing the machine on the line, it is well to have some method of bringing the rotary up to speed, or properly synchronizing the same. This can be done by means of a polyphase induction motor. If such a motor is used it must be capable of synchronizing the rotary, and also overcoming the rotary iron and friction losses when the rotary field strength is sufficient to give approximately normal direct-current voltage at synchronous speed. The purpose of the so-called starting motor test is to determine whether the motor is properly adjusted to meet these conditions.

The field charge necessary to give normal direct-current voltage at synchronous speed can be found from the results of the iron loss and saturation test. Now if the resistance of the starting-motor secondary could be properly adjusted beforehand, so that with a certain impressed alternating-current voltage on the motor the right speed would be obtained, we could at once synchronize the rotary under the normal conditions of just sufficient field current to give approximately normal direct-current voltage. It is not possible, however, to always meet these conditions on first test, and hence it becomes a matter of adjustment, as far as the motor secondary is concerned, to obtain synchronizing speed.

To effect this adjustment necessitates a change in the resistance of the motor secondary, and this is accomplished by first making the secondary short-circuiting rings of a little greater cross-section, *i. e.*, of a little less resistance than that which will give the desired speed. This greater cross-section permits of the rings being cut away after a first test, thereby gradually increasing the resistance of the secondary until upon further testing same the proper speed for the best synchronizing results is obtained.

In making a test of this kind, one of the points to be noted is the voltage at which the motor starts. By starting low enough and gradually increasing the impressed voltage on the motor, this may be determined. If the normal voltage on the alternating-current side of the rotary is 390 volts, and the motor refuses to start on less than 410 volts, it indicates that some change in the design must be effected. In another case the motor might start with an impressed voltage as low as 300 or 325 volts, and rapidly speed up the rotary beyond synchronism to such a point that we might find we have a voltage on the direct-current side of 700 or 750 volts.

Hence in making the first test on the motor under these latter conditions, it is very often necessary to put a small external load on the direct-current side of the rotary, in addition to the normal field charge, in order to pull the starting-motor speed down to somewhere near synchronous speed. This indicates that the starting-motor speed must be cut down by increasing the resistance of the secondary. Doing this decreases the slip, and upon second test we will probably be able to get the results desired. If not, the resistance of the rings must be further increased.

In the first case, with a three-phase rotary, 650 volts direct-current, let us assume that we get the following results:

Motor.	Rotary.			
Impressed Alternating-current Volts.	Direct-current Volts.	Kilowatt Losses.	Direct-current Amperes.	Field Amperes.
385	652	7.35	25	2.20

That is, the motor may have started with an impressed voltage of say 395 volts and carried the rotary up to such a point above synchronous speed as would give 700 volts direct-current, and in order not to exceed synchronous speed and get approximately normal direct-current voltage, it was found that an external load of about twenty-five amperes was required.

After altering the resistance of the motor secondary as explained above, and making a second test, we may find that now no external load is necessary to bring the speed down, and the following results are obtained:

Motor.	Rotary.			
Impressed Alternating-current Volts.	Direct-current Volts.	Kilowatt Losses.	Direct-current Amperes.	Field Amperes.
385	647	7.30	0	2.20

To obtain these results, corresponding as nearly as possible to the normal operation of the rotary, means the proper adjustment therefore of the starting motor, and is the object of the test.

In actual service it will be found that the brush tension on rotaries varies all the way from two or three pounds per brush to ten pounds per brush. In order to make sure that the starting motor will operate under all such conditions, it is customary to make a starting-motor test after the rings have been adjusted, first with about two and one-half pounds tension per brush, and second with say ten pounds tension per brush. In the latter case it will be necessary to reduce the field current, thereby cutting down the iron loss an amount corresponding to the increased brush friction loss, in order to obtain the desired starting-motor conditions. The field having been weakened, the direct-current voltage will, of course, be below normal at synchronous speed. This test will indicate what the decrease in the direct-current voltage is, and how the motor acts under these abnormal conditions.

4. Temperature Test—The usual temperature test on a rotary converter is made with the direct-current side short-circuited. The chief object of the run is to "season" the commutator. The length of the run varies from about six to eight hours. This is, however, more a matter of judgment and observation of the condition of the commutator after a few hours run with such a load.

The Present Position of the Theory of Electrolysis.

A recent number of the *Electro-Chemist and Metallurgist* contains an able article by Mr. W. C. D. Whetham on the present position of the theory of electrolysis. The investigations which led up to the theory of electrolytic dissociation and the modern convective views of electrolysis are traced, and it is clearly shown that a vast number of important observations are easily explained by the modern views. As the author points out, experiments on the comparison of the electrical and the osmotic values of ionization are of little use from the point of view of the contro-versialist seeking arguments for or against the ionic dissociation theory. The deviations between the two values are, however, in most cases easily explainable by a consideration of the interionic forces, which probably exert an effect even at dilutions at which the intermolecular forces are negligible, and, further, of the complex ions which are so often formed in solution.

INDUSTRIAL ELECTROCHEMISTRY AND ELECTROMETALLURGY.[1]

NOTES ON PROGRESS IN EUROPE AND AMERICA.

BY JOHN B. C. KERSHAW.

Electrolytic Copper by the Elmore Process.

The Elmore companies for production of tube and sheet copper by electrolysis (see first series of notes, January 24, 1903), according to the last reports, have not yet surmounted the financial troubles due to the unsettled state of the copper market in 1900 to 1901. At the annual meeting of the shareholders in the German & Austro-Hungarian Metal Company held in May, the chairman stated that during the last ten years $250,000 had been paid by the company as interest upon debentures and loans, and that nearly $150,000 had been charged to repairs and depreciation. The profit of the past year's trading are insufficient to clear off the debit balance in the company's accounts, and there was consequently no dividend for the ordinary shareholders. A modification of the original Elmore process for producing small tubes of electrolytic copper, is to be introduced at the Schladern works, and the machinery for this is being constructed in America. The company's water power plant at Schladern has not proved very reliable in times of drought; and a full steam power plant has therefore been installed as reserve.

The report presented to the shareholders meeting at the Leeds copper works (the English Elmore company) in the same month was less satisfactory than that of the German company. There was a loss on the year's working, which was only wiped out by the rise in the value of the stocks of copper held by the company. There was also an overdraft at the bank amounting to $230,000. Up to May, 1902, this works had been turning out only two and one-half tons of tubes per week, but since that month the manager had been gradually increasing the output, and by December, 1902, it had risen to thirty-four tons per week. In order to increase the revenue of this company, the surplus land and power at the Leeds works are to be sublet to suitable customers. More capital is required to enable this company to carry on its manufacturing operations satisfactorily; and at present it is employing the resources of the bank for the provision of the necessary working capital.

The Position of the Calcium Carbide Industry in Europe.

Under the new duty regulations affecting the import of carbide into Germany, it is hoped that the German carbide works will be enabled to resume their full working activity, and to supply the whole of the home demand for this product. The duty upon imported carbide has been fixed at six francs per 100 kilogrammes (equal to $11.80 per ton), and it is especially aimed at the imports from Norway and Switzerland.

In view of this improvement in the outlook for the German carbide industry, it is interesting to note that a new carbide works is being erected at Zwickau in Bavaria, where 2,000 horse-power has been developed upon the river Ohe. The Nuremberg Syndicate, which practically controls the prices of carbide in central Europe, has fixed the following prices for districts under its control: South Germany, 24.50 marks per 100 kilogrammes; Berlin, 25.50 marks per 100 kilogrammes; Cologne, 25.95 marks per 100 kilogrammes. The price for export is considerably higher on account of the greatly increased charge for freight to the seaboard; and the amount of German carbide exported is therefore small.

The following figures for the weight and value of the calcium carbide exported from Switzerland in recent years show how dependent the industry in that country is upon its export trade.

	Weight. Meters.	Value. Francs.
1900.....	44,157	1,548,000
1901.....	42,865	1,287,000
1902.....	55,844	1,708,000

The large total of 24,000 horse-power has been developed for the manufacture in Switzerland, but a large portion of this is still unutilized.

In Italy the carbide industry is being rapidly developed, and whereas in 1897 only 250 tons were produced in 1900 the home production had risen to 1,400 tons, and in 1902 to 4,800 tons. The value of the output was estimated to be 950,000 lire in 1900, and 2,880,000 lire in 1901.

As regards the use of acetylene for village lighting in Germany, Vogel in a recent report has stated that in the early part of 1902 twenty-five German village communities had been provided with central installations for generating the gas from carbide. The average price of carbide was twenty-eight marks per 100 kilogrammes; and at this price the gas could be profitably sold at 1.80 marks per cubic metre. A complete village installation for a village of 4,500 inhabitants cost 70,000 marks in Germany.

Electricity for Iron and Steel Production.

Since the publication of the special illustrated article by the writer upon this use of electricity in the ELECTRICAL REVIEW (see issues of June 6 and 13, 1903) a large amount of information relating to this subject has found its way into the columns of the technical papers and journals. The opinion of the writer that these electrothermal processes will be chiefly useful for producing special brands of steel and alloys of the same, finds confirmation from these more recently published facts and figures; and it would now seem to be generally accepted, that the electrical processes will not compete with the ordinary blast-furnace procedure in the reduction of normal iron ores. Keller in a recent paper has stated that such competition is only possible where the cost of the kilowatt year does not exceed $7.12. As there are few places where electrical energy can be generated for this sum, the owners of blast furnaces may remain calm and content.

According to recent statements by the inventors and exploiters of these new processes, scrap iron or scrap steel is most generally used as raw material. The electric process is really one of refining; the impurities being driven out of the scrap iron or steel by the high temperature attained between the electric arcs used for heating the furnaces.

One of the most important developments of this branch of metallurgy is the production of ferro-silicon; the works of Keller, Leleux & Cie in France being one of the first to produce this alloy in large quantity by the electrical method. Details of this new manufacture and of its development in France were recently given in these columns. (See ELECTRICAL REVIEW, August 15, 1903.)

Chrome steel is another alloy which is being produced on a large scale in the electric furnace by the Heroult process, at Le Praz in Savoy. 14,000 horse-power is available at this locality and the works of the Compagnie Electro-metallurgique Française produce aluminum, steel and chrome steel by the Heroult methods.

Ruthenberg in a recent paper upon his own process (see ELECTRICAL REVIEW, September 26) has given further information which proves that the Ruthenberg process differs in essential details from the electrothermal processes now being tried upon an industrial scale in Europe. Only magnetic ores are suited for treatment by the Ruthenberg process, and the effect of the passage through the magnetic rolls is to obtain an "agglomerated" mass of ore, which still requires smelting and reduction. It is not clear from the author's paper, whether ordinary metallurgical methods are employed for this after reduction.

The expenditure of power has now been reduced to 250 kilowatt-hours per ton of ore.

[1] This is the second chapter of a new series of notes. The first series appeared from January to April, 1903.

REPORT ON THE EDISON STANDARD CELL FOR AUTOMOBILES.[1]

BY W. HIBBERT.

Description of Cell—The Edison standard automobile cell is of rectangular shape. It stands thirteen inches high (over all) and measures 5.1 by 3.5 inches horizontally. It weighs 17.8 pounds. It contains fourteen positive and fourteen negative plates. Both positive and negative plates are alike, except in respect of the active materials. The pockets on the negative plate contain finely divided iron, those on the positive contain peroxide of nickel. The liquid is a twenty per cent solution of potash. This suffers no change during the action of the cell, except the loss of a small quantity of water which is decomposed while the cell is being charged.

Electrical Qualities—The electromotive force is 1.33 volts. The internal resistance is 0.0013 ohm.

Output—The output at sixty amperes is 210 watthours, or at the rate of 11.8 watthours per pound of cell. When the cell is examined as to discharging values its excellence becomes most pronounced. At high rates of discharge rising to many times the normal, it suffers no appreciable polarization, and therefore recovers its normal voltage almost instantaneously when the current returns to an ordinary value.

In relation to the weight of the cell, the output is high. It amounts to 11.8 watthours per pound of cell. If we compare the specific output of the Edison cell with that of the better lead cells made for traction, we find that the watthours are twenty-five to fifty per cent greater.

In making the experiments on output at different discharge rates, one set happened to be taken on very hot days. The temperature of the cell rose to something like fifty-three degrees centigrade. At this high temperature the output was increased, but not more than would result from the consequent fall in the internal resistance of the liquid, as these high-temperature discharges occurred at the beginning of the tests, and I found the cells were not at all worse for being exposed to such heating.

Short-Circuit—One of the smaller cells was short-circuited for forty-eight hours. After a subsequent long charge, it gave a discharge somewhat less than normal. But after a second charge, it had recovered so well that the discharge could only just be distinguished from the normal.

Flexibility of the Cell—In order to ascertain the readiness with which the cell recovered from an excessive transient discharge, the current was made to alternate from sixty to 230 amperes, a careful watch being kept on the voltmeter to see how it responded to the variation in current. Recovery was practically instantaneous.

High Rate of Charging—The cell can evidently give a high discharge rate, and tests to prove the charging rates made so far have been:

1. One hour's charge at 177 amperes. Discharge 124 ampere-hours seventy per cent of charge.

2. One hour's charge at 150 amperes. Discharge 107 ampere-hours seventy-one per cent of charge.

3. One hour's charge at about 205 amperes. Discharge 142 ampere-hours seventy per cent of charge.

These figures show that the cell is able to absorb the charge at these high rates and to discharge a very large fraction of that which has been thus absorbed.

Continued Discharge at Low Voltage—Experiments on excessive discharge indicate that when the potential difference reaches the value 0.9 volt, it falls very rapidly indeed with all ordinary currents. If the discharge be kept up, the fall is arrested when the voltage reaches a value of about 0.5 and the current flows steadily for some time at this lower pressure.

There is thus an addition to the watthours which the cell can supply. So far I have not been able to detect any injurious effect as a result of this low-voltage discharge. But here, as in the case of the short-circuited cell, there is need for subsequent excessive charging.

Effect of Rest—Many experiments have been made on the effect of rest on a discharged cell, all resulting in evidence that such a trial does not injure it.

The effect of rest on a charged Edison cell was tested in the following way. A cell was discharged at sixty amperes immediately after charging and gave 170 ampere-hours. It was again discharged, after allowing two days' rest to intervene between charging and discharging. The result was 155 ampere-hours, or ninety-one per cent of the full discharge. Part of the deficiency (nine per cent) was attributed to the loss of current due to the gases which help to fill the pockets at the end of a charging operation. The cell was again charged and put aside for twenty-six days. It then yielded 124 ampere-hours.

If this be compared with the full discharge (taken immediately after charging) it equals seventy-three per cent, a loss of twenty-seven per cent.

But this is hardly representatively true. Some of the apparent loss is due to the gas effect, and we get a better notion of the loss due to resting if the figure be compared with that observed after two days' rest.

Compared in this way, the cell gives eighty per cent of the charge, after an additional rest of twenty-four days.

Efficiency—The efficiency varies with the charging and discharging currents, as might be expected.

At thirty amperes, the watthour efficiency is about sixty-six per cent.

At sixty amperes, it is about sixty per cent.

Charged at 100 amperes and discharged at sixty, the efficiency fell to about fifty-six per cent.

Charged at the high rate of 177 amperes and discharged at sixty, the efficiency was almost exactly fifty per cent.

OBSERVATIONS ON THE ROAD.

It seemed desirable to seek an opportunity of watching the cells on the road, and Mr. Dick placed a car at my disposal. The car was driven by a Westinghouse motor, actuated by thirty-eight "Standard" Edison cells, exactly like that on which my laboratory tests were made.

The total weight of the car with two people was 1,950 pounds, the battery with its case weighing 700 pounds exactly. Unfortunately the motor chosen was too low a rating and was therefore overloaded all the time. There was a consequent lowering of its efficiency, which makes the tractive effort appear somewhat high. But this in no way affects the test as far as the battery is concerned. To get at definite data for the cells, I traveled with notebook in hand and kept a record of the voltmeter and ammeter readings, leaving my driver to attend to the car. The programme of work with the car was arranged not so much with the object of running a long distance as to finding answers to certain questions.

The following table exhibits the actual and relative output at varying discharge rates:

Discharge Rate in Amperes.	Time of Discharge.	Output in Ampere-Hours.	Per Cent of the Thirty-Ampere Output.
30	5 hrs. 46 min.	173	100
60	2 " 51 "	171	99
90	1 " 51 "	167	96.5
120	1 " 21 "	162	93.6
150	1 " 2 "	154.5	89
200	42 minutes.	142	82

[1] Abstract.

IS THE CAPACITY ON THE ROAD EQUAL TO THAT FOUND IN THE LABORATORY?

To ascertain this, a standing discharge of the thirty-eight cells was taken before starting on my journey. It equaled 159 ampere-hours. The figure, however, was required not for comparison with any previous experience, but in order to discover if it could be equaled while running on the road.

This proved to be the case. Several discharges justified this assertion. For example, on September 9, during a run of three and one-half hours, eighty observations of the ammeter were taken. From these, I calculate that 150 ampere-hours were delivered. As the cell was not quite discharged—the volts being above 0.80 per cell—it is evident that we were getting quite as much while running as was yielded on the laboratory table.

WILL THE BATTERY STAND EXCESSIVE DISCHARGE RATES ON THE ROAD?

A thirty-two-mile run from Leicester to Northampton, England, was made with wind generally dead ahead and very strong, the rain also falling in great quantities. No record could be taken, but the current on the level was about fifty-five to sixty amperes instead of forty. On the slopes it was frequently ninety to 120, and on one hill the ammeter index passed beyond the stops and must have indicated a current over 150 amperes.

As my mind was very keenly observing the ammeter during the journey, I estimated the output immediately we got to Northampton (four hours run against 2.5 hours on a fine day) and made it at least 190 ampere-hours. This high-discharge capacity was due to the low-voltage discharge already alluded to.

The important point, however, is that the discharge current mounted up to 150 or 160 amperes and that currents not quite so high were often called for, without injuring the cells.

The battery was charged without difficulty at Northampton, and ran next day in a very efficient manner.

WILL THE BATTERY TAKE A RAPID CHARGE (SAY ONE HOUR) AND UTILIZE IT IN DISCHARGE ON THE ROAD?

At Leicester, the car was run down till the voltmeter showed 0.75 volt per cell. It was then charged for one hour at 150 amperes—the maximum current then obtainable. The subsequent discharge on the road gave 107 ampere-hours, which is seventy-one per cent of the charge. Distance run thirty-two miles. It is evident, therefore, that a rapid charge is effectively absorbed. The figures for efficiency on the road are, for rapid charging, exactly what I found in the laboratory.

WILL THE BATTERY RECOVER AFTER STANDING IDLE IN A DISCHARGED STATE?

On returning to London, the car was run about till the speed and also the voltmeter showed that the cells were run down very low. The car was then put aside for ten days so as to stand idle in a discharged state.

At the end of that time it was charged, and to make the test more severe it was charged as follows:

	Ampere-Hours.
40 minutes at about 200 amperes..	156
16 " " 120 " ..	30
Total.....	186

given in one hour. The car was then run about London and covered thirty-one miles, yielding 134 ampere-hours. The efficiency was seventy-two per cent, the same figure as obtained in laboratory. From this behavior it is evident that the thirty-eight cells were not hurt by the harsh treatment they had received.

DOES THE CAPACITY CHANGE DURING WORK ON THE ROAD?

The final runs were as good as the initial, taking corresponding days. But by taking a standing discharge very accurately at the commencement of the trials and repeating it when the trials were over, I hoped to discover if the capacity had changed by as much as one or two per cent.

At Paris the capacity was 159 ampere-hours. At London, after all the road running, the capacity was 158 ampere-hours and the curves of discharge could not be distinguished from each other. In other words, both the quantity and the pressure were unchanged.

Life—The question of life is to be decided in a positive way by nothing short of a continuance in working order. But the evidence advanced in many other points has a very cogent, though indirect, bearing on the question of life. When it is shown that the capacity has not changed by one per cent after a 500-mile run, there is a definite ground for thinking that the life will certainly not be short. This can now be confirmed by the fact that practically the same figure was obtained after an additional 900-mile run.

Other points which tell in the same sense, are the regularity of the charge and discharge values in separate trials under all circumstances—proving that the original conditions are reproduced again and again.

My conclusions may be summarized thus: the Edison cell shows

(*a*) Greater work output per unit of weight.

(*b*) Greater flexibility of working.

(*c*) Greater working range of current.

(*d*) Greater ease and safety on handling.

(*e*) Greater stability, both mechanical and electrical.

The Growth of New York Telephone Service.

Only a short time ago the telephone was looked upon as a queer invention, more a plaything than a new-born factor bound to become the great factor it has become in commercial and social life. After the first central office was opened in New York city, telephones were slowly installed until at the beginning of 1890 there were about 8,000 in service, the ratio of telephones to population being about one to one hundred and sixty. During the four following years there was an increase of about 2,500, an average of 625 a year. Up to this time the telephone was the unit of charge. The rate paid was for a telephone without regard to the number of times the telephone was used. It was referred to as the "annual rental." Not quite ten years have elapsed since the message became the charge unit and the number of stations has increased to 120,000. The subscriber is not paying a "rental" for a telephone, but he is paying for a service and his rate of payment is based on the amount of service furnished. That the message is the proper charge basis is proven by the great increase in the number of telephone subscribers.

Notwithstanding this rapid growth, the New York Telephone Company has, in the face of great difficulties, extended its plant to care for these additional subscribers without serious delay.

Though the telephone established itself permanently in the business world long ago, it has but recently become an important element in residence appointments. Conservative residents of Manhattan were not sure that the service would be of value, and a great many thought it would be a source of annoyance. All this is changed, however, and the number of residence stations now being installed in Manhattan is even greater than the number of business stations.

The value of residence telephone service is appreciated by those who are enjoying it, the cost is reasonable and the service is good. Besides affording a prompt communication with those who cater to the family wants, it brings relatives and friends within ready touch at all times. In emergencies its value can not be calculated.

The number of telephone stations in Manhattan and the Bronx—at present, 120,000—is increasing at the rate of 2,500 a month. The ratio of telephones to population is about one to nineteen.

The telephone is making a peaceful invasion of every residence in Manhattan and the Bronx. As long as the present efficient service is maintained this invasion will be marked by a still greater increase in the number of subscribers and a decrease in the ratio of telephones to population.

Extensive Dredging Operations by the United States Government.

An indication of the large amount of river and harbor improvement work now under way or contemplated by the United States Government is given by the fact that at present ten suction dredges are being built, two of which will be sent to Great Lakes, two to New York harbor, two to the Mississippi river, two to Charleston, S. C., one to Galveston and one to Savannah, Ga. The contracts for building these vessels have been distributed to a large number of builders, possibly for the purpose of hastening their completion. Five are being constructed by the Maryland Steel Company, two by the Jas. Reilly Repair and Supply Company, and one each by the W. R. Trigg Company, the Petersburg Iron Works Company and the New York Ship Building Company.

The mechanical equipment of the dredges for salt-water service will include surface condenser outfits with Blake air pumps, feed pump, fire pumps, etc. The dredges for the Great Lakes are provided with very large Blake cross-compound, double-acting, air pumps and jet condensers with the usual complement of Blake vertical duplex feed pumps, fire pumps, etc. The air pumps are of a very novel arrangement, inasmuch at it is possible by the manipulation of valves and cocks provided for the purpose to cut each pump in half and run one side entirely independent of the other side. This practically provides a spare pump in each installation without the necessity of being overweighted with two duplicate machines, and at the same time secure the advantages of compound steam cylinders.

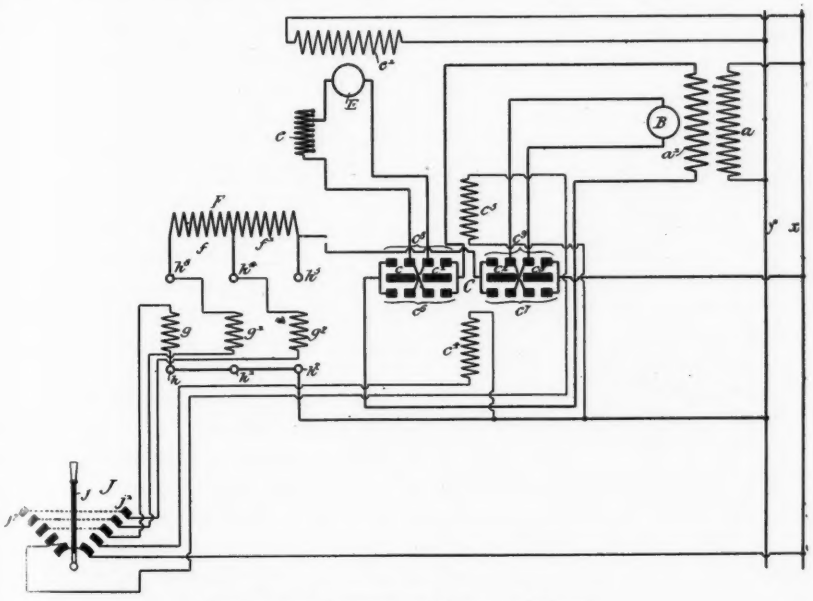
The operation of these machines is very interesting. A long flexible tube twelve to fifteen inches in diameter drops down from the side of the vessel twenty to thirty feet or more to the bottom of the river or harbor upon which the dredging operation is being performed. The upper end of this tube is connected to an immense rotative centrifugal pump revolving at several hundred revolutions per minute and capable of handling many hundreds of tons of water per hour. The lower end of the tube is manipulated from the vessel against the sand bars and mud banks, and as the water is sucked upward by the centrifugal pumps a very large proportion of sand and mud goes with it. The centrifugal pump discharges this water with its suspended material into the tanks on board the vessel or into scows, where the heavy matter quickly settles to the bottom, the water flowing back into the sea.

Electrical Patents.

The General Electric Company has purchased the entire interest in a patent granted to Charles H. Ingalls, of Danvers, Mass., on a commutator. This invention relates to a process of treating metal in order to regulate the friction between moving surfaces. It has especial reference to the commutators of electrical apparatus, such as rotating meters. Moving surfaces between which frictional contact is maintained are liable to alter with respect to the coefficient of friction. In the case of a recording wattmeter this change in the friction between the commutator and the brushes is a serious matter, since it necessitates readjustment of the starting coil to properly compensate for this frictional load. An electric power company is therefore put to considerable expense for the services of employés required to look after the meters, besides the annoyance of having its customers doubt the accuracy of the meter readings. It is found, however, that with the lapse of time the necessity for readjusting disappears. The surfaces of the commutator and the brushes seem to reach a condition of stability with a permanent and unchanging degree of friction. At this point of time the light load accuracy has decreased all that it is likely to from commutator causes, so that a motor corrected after this critical point has been reached retains its accuracy so long as the jewel bearing remains good. It is inferred from this that the surfaces of the commutator and brushes undergo some chemical change from gases in the atmosphere, especially corroding gases, such as contain sulphur. Mr. Ingalls has discovered that by applying to the surfaces in question a solution of sulphide or polysulphide the surfaces will be chemically altered by the union of the sulphide and the metal of the surfaces treated and that the surfaces so treated will not thereafter be further changed by the action of the atmosphere. Furthermore, so far as the commutator and the brushes enter into the proper running of the meter their condition will remain stable, and the accuracy of the meter, particularly on small loads of five per cent and over of the rated capacity of the meter, will be very reliable. The process invented may be carried out as follows: A saturated solution is made of any soluble sulphide, preferably potassium polysulphide. The vehicle is alcohol, and to this is added considerably more commercial "liver of sulphur" than will be dissolved by the quantity taken. This solution is applied to the surface to be treated, such as the commutator and brushes of a meter, by any suitable means, such as a camel's hair brush, which is preferably only moistened with the solution and held lightly against the commutator while the latter is being rotated. This application of the solution is repeated several times until the commutator shows no further change. The surface of the commutator is then polished with linen tape or the like. The solution can be applied to the meter brushes, either by using the camel's hair brush or moistening a piece of absorbent material and placing it on the brush, or by dipping the meter brush tips in the solution itself. The brush contact surfaces are also polished with linen tape. The result of this process is to quickly produce on the surfaces treated a thin coating of the sulphide of the metal of which said surfaces are composed. Copper or silver is generally used for the commutator bars of recording meters, so that the coating formed thereon will be a sulphide of one of these metals. Alcohol or ether is preferred to water as a solvent because it aids in cleaning the surface to be treated and enables the sulphide to act more efficiently. The coating is not only a protection against the corroding effect of gases in the atmosphere, but it may slightly reduce the conductivity of the commutator, since it is not so good a conductor as the pure metal. This, however, is easily allowed for in the adjustment of the starting coil, so that a meter thus treated requires no subsequent correction on account of the commutator and brushes. Greater accuracy is thus attained, and all the annoyances of frequent readjustment are obviated.

Arthur C. Eastwood, of Cleveland, Ohio, has invented a new system for the control of electric motors. The invention relates to a new combination of apparatus particularly designed for the transformation of electric into mechanical energy, having for its object the provision of means whereby the torque which may be transmitted by an electric motor will be limited to a certain predetermined extent, so that the receiving apparatus or structure to which the motor is operatively connected can not be strained by the exertion of an excessive torque thereupon. The invention also has for its object the provision of means whereby it is possible to arrest the motion of a load operated upon—as, for example, increasing it beyond the predetermined amount—and yet permit the armature of the driving

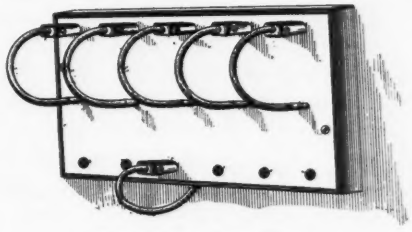
motor to continue to rotate so as to continuously transmit to said load the predetermined maximum torque. The object of the device is thus to protect both the driving motor and the receiving device, to which it is connected, from the injurious effects of overloads. There are a number of applications to which electric motors in the past have been found to be poorly adapted, owing to the fact that an ordinary motor can not permit of its armature being brought to a standstill without injurious results either to the armature itself or to the machine to which it is attached. When the armature of a direct-current motor is brought to rest under load, the current which will flow through it is limited only by the ohmic resistance of the armature and its connections, the current being in general many



System for Control of Electric Motors.

times the full load running current of the motor, so that the windings of the armature will be in danger. Further, the excessive torque which will be delivered by the motor under such conditions endangers the gearing or other parts of the machinery to which the armature is connected. An electric motor in this respect is radically different from a steam, hydraulic or compressed-air motor, the action of which may be arrested by an increase of load without danger either to itself or to the device to which it is connected. One application of the invention is to the opening and closing of the bucket on machines ordinarily used in unloading ore, coal and other raw material from the holds of vessels. In the operation of such machines the bucket in closing will frequently bury itself too deeply in the material which it is to handle, so as to arrest the closing thereof, and if the material contains large lumps the jaws of the bucket will frequently have a large piece wedged between them before they reach their fully closed position, thus bringing to a standstill the closing mechanism. While it has been feasible to employ electric motors for the operation of the majority of movable elements of unloading machines, it has sometimes been found necessary to operate the bucket-opening and closing mechanism by means of fluid-actuated pistons acting in suitable cylinders. As will be understood by those skilled in the art, it has therefore been necessary to generate upon the unloading machine itself the pressure for the operation of the closing mechanism, thus making it necessary to equip each unit with a hydraulic pressure pump driven by an electric motor, an accumulator, and an elaborate system of piping, in addition to which means must be provided for frequently replenishing the liquid of the hydraulic system, particularly if water be employed. It will therefore be understood that if an electric motor could be employed for operating the bucket mechanism a large amount of complicated machinery could be dispensed with, and the operation of unloading the machine would thereby be made simpler and more reliable.

A novel telephone exchange particularly useful in small systems has been patented by Mr. Charles S. Exley, of Clarke County, Iowa. Broadly stated, each line is provided with an independent signal connected with its line by a switch. A plurality of independent exchange contact devices are employed, each having a number of spring jacks that are adapted to be connected with the different lines by the switch employed for connecting the lines with the signals. The usual exchange in-



Telephone Exchange.

strument is adapted to be connected with any of these exchange contact devices by means of a switch comprising a flexible cord and plug. Under normal conditions the line wires are connected with their respective signals, so that, should a subscriber call up central, his signal will indicate the call at the exchange, thereupon the operator connects his instrument with one of the exchange contact devices, and at the same time disconnects the line wire from the signal and connects it with the same contact device. This throws the subscriber and operator of the switch in communication and upon ascertaining the number the caller desires, the plug from that number is removed from its signal contact and attached to the exchange contact device. This places the two parties in communication and at the same time the operator can ascertain when the subscribers have finished.

Some time ago a patent was obtained on sharpening razors and other implements having keen edges by means of magnetism, the inventor of the original idea placing a bar magnet in line with and spaced from the edge. He claimed that this would tend to align the minute ragged teeth, which an examination under a microscope has shown to be the makeup of the cutting edges. Further experiment has shown a tendency of the magnet to draw toward the poles, and consequently the tendency is to improve only parts of the edge. On the other hand, Mr. Theron Davis, of New York, N. Y., has found that by magnetizing the edged tool, and

Sharpener for Edged Tools.

then holding a bar of soft iron or other attractive metal opposite the edge, the magnetic attraction is exerted the entire length of the same and a uniform sharpening is obtained. This improvement, which is practically a reversal of the original idea, has recently been patented by Mr. Davis.

A New Steam Turbine Patent.

A recent British patent granted to the British Thomson-Houston Company, Limited, London, and Robert Wilson relates to improvements in steam turbines, and has for its object to provide a slow-speed machine in which the expansion of the steam may be effected in a smaller bulk of appliance than hitherto employed for this purpose. The following description is from the London *Mechanical Engineer*:

The turbine, which is illustrated in Figs. 1 and 2, comprises a wheel A on which is provided a number of buckets D. These buckets are formed of a number of inverted V-shaped blades projecting radially from the periphery of the wheel, and are held in position between flanges E bolted to the opposite sides of the wheel. The peripheries of these flanges revolve in working engagement with the

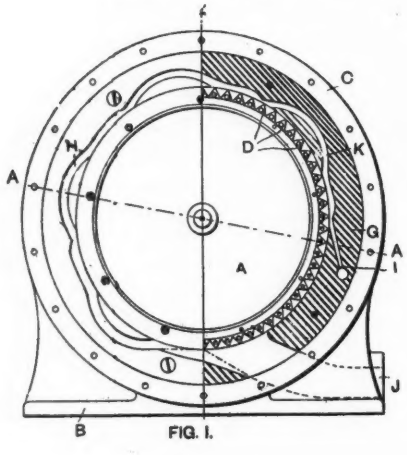
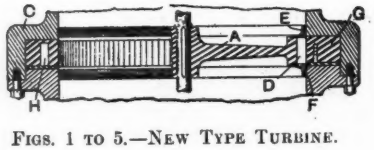


FIG. I.

FIG. 2.



FIGS. 1 TO 5.—NEW TYPE TURBINE.

interior of the surrounding casing, and the joints between them are formed by a number of small grooves F in the peripheries of the flanges, in which steam condenses and forms a water joint. Suitable working clearance is left between the tops of the vanes and the surrounding casing.

On the interior of the casing C is a ring G in which is formed a sinuous passage H extending around the ring and gradually increasing in area from the inlet I to the exhaust J. This passage at the inlet end is constructed as a pressure-reducing nozzle, so as to wholly or partially convert the pressure energy of the steam into kinetic energy by increasing its velocity. Steam entering the casing through the inlet nozzle I (see Fig. 5) impinges on the buckets opposite, and is deflected from them into a succeeding part K of the sinuous passage H, which is of greater area than the inlet passage I so as to accommodate the increased volume of the steam due to the drop in pressure resulting from the transference of energy to the wheel. The steam as it emerges from this second part of the passage again impinges upon the wheel buckets, and is deflected from them into a third portion of the sinuous passage of still greater area than the second. This operation is repeated until the exhaust is reached, the number of parts of the wheel to which steam is supplied being proportioned according to the range of expansion with which it is desired that the wheel shall operate.

Where the whole range of expansion

FIG. 3.

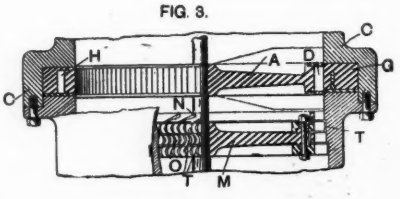


FIG. 4.

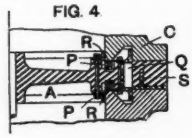


FIG 5.

can not be conveniently obtained on a single wheel, two or more similar wheels may be employed, the steam being exhausted from one wheel into the other. This compounding may also be effected upon a single wheel, one method of doing which is illustrated in Fig. 4. In this case the wheel A is provided with three sets of vanes P, P_1 and Q, the sets P and P_1 being identical, and both receiving the steam at boiler pressure through the sinuous passages R and R_1, the combined exhaust being led into a sinuous passage S, and operating on the set of vanes Q, the area of inlet to passage S being equal to or slightly larger than the combined areas of the exhaust ends of the passages R and R_1.

Another method of compounding is shown in Fig. 3, where the steam is exhausted from the wheel A into a small turbine M of the parallel-flow type mounted upon the same shaft, and which may be enclosed in the same casing. The steam after passing through the turbine wheel A, which is constructed as above described, is exhausted through the nozzles N of the parallel-flow turbine M, and completes its expansion in passing through the fixed and movable blades O and T in a manner now well known. Instead of a parallel-flow turbine a radial-flow turbine might be used.

The operation of the turbine is as follows: Steam at a high temperature and pressure is admitted into the expanding nozzle inlet I, in which it increases in volume with a proportional increase of temperature, and acquires projectile velocity and kinetic energy, with which it impinges upon the vanes D attached to the wheel A, to which it imparts some of its kinetic energy, thereby causing it to rotate. The steam is deflected from the vanes into the part K of the sinuous passage H, from whence it emerges and again impinges on the vanes, imparting to them a still further velocity, and from which it is again deflected into the sinuous passage H. This cycle of operations is repeated until its kinetic energy is exhausted and its velocity is practically the same as the wheel.

Braking Tests of Cars and Automobiles.

The French extra Parliamentary Commission on Automobilism has held a series of comparative tests of the braking power of cabs and automobiles, the results of which are described in the English *Mechanic and World of Science*. A trial was made on the Bois de Boulogne. The macadam of the road was very greasy, and the shoes of the horses were able to obtain a better grip than the tires of the cars, which nevertheless scored a triumph. Two single-horse cabs, one two-horse coupé, a six-horse-power light car, and a forty-horse-power car, weighing nearly thirty hundredweight, competed. At seven and one-half miles an hour an ordinary cab stopped in thirty feet. Both the motor cars stopped in ten feet. At ten miles an hour the best of several attempts showed that the single-horse cab came to a standstill in forty feet, and the cars in thirteen feet. At twelve miles an hour the two-horse coupé covered forty-three feet before stopping, while the cars pulled up in seventeen feet. Following this, one of the horses, in endeavoring to stop, was severely strained, and was not able to take part in tests at higher speeds. At sixteen miles the cars pulled up in thirty-four feet, and at twenty-four miles an hour, in sixty feet. On a dry road the results would be still further in favor of the automobiles. The conclusion is reached that horses are very inefficiently braked.

The Forty-eighth Annual Meeting of the American Society of Mechanical Engineers.

The forty-eighth meeting of the American Society of Mechanical Engineers held its opening session in the society's parlors 12 West Thirty-first street, New York city, on Tuesday evening, December 1. Mr. James M. Dodge, president of the society, delivered the annual address. His subject was "The Money Value of Technical Training." The reading of the presidential address was followed by a "smoker."

The second session was held December 2, in the hall of the Mendelssohn Union, 113 West Fortieth street. This was the annual business session for the report of the council, tellers, and of committees standing and special.

The officers elected were: President—Mr. Ambrose Swasey, of Cleveland, Ohio. Vice-presidents—Mr. O. S. Jacobs, of Hoboken, N. J.; Mr. M. L. Holman, of St. Louis, Mo.; Mr. A. Mattice, of Pittsburg, Pa. Treasurer—Mr. William H. Wiley, New York. Secretary—Fredrick R. Hutton, New York. Members of council—Mr. George J. Rockwood, of Worcester, Mass.; Mr. John W. Lieb, of New York, and Mr. W. J. Keep, of Detroit, Mich.

The papers read were: "Is Anything the Matter With Piece Work?" by Mr. Frank Richards. Mr. Richards contrasted the piece-work system of paying workmen with various other schemes, among them the so-called "premium plans," and concluded that the piece-work system was "advancing on its merits as the most honest way of paying for repetitive work in the machine trade as in all others." "Modifying Systems of Management," by Mr. N. L. Gantt; "Slide Rules for the Machine Shop as a Part of the Taylor System of Management," by Mr. C. G. Barth; "What Are the New Machine Tools to Be?" by Mr. J. E. Sweet; "Suggestions for Shop Construction," by Mr. F. A. Scheffler.

In the afternoon the members of the society were guests of the Edison Illuminating Company, of New York, and of the Interborough Rapid Transit Company on a tour of inspection of the east side power-house.

A theatre party was formed in the evening which concluded the day's programme.

The third session was held Thursday morning, December 3, in the auditorium in the main building of Stevens Institute of Technology, Hoboken, N. J. The professional papers read and discussed at this session were: "The Pitot Tube," by Mr. W. B. Gregory; "Methods of Determining Rates and Prices for Electric Power," by Mr. F. B. Perry; "Three and Four-Wire Multiple Voltage Systems," by Mr. R. A. Gillet; "Test of a Compound Engine Using Superheated Steam," by Mr. D. S. Jacobus; "The Pressure Temperature Curve of Sulphurous Anhydride (SO_2);" by Mr. E. F. Miller, and "Construction and Efficiency of a Fleming Four-Valve Engine," by Mr. B. T. Allen.

Professor Hans Goldschmidt of Essen, Germany, also described and demonstrated the powers of thermit in an illustrated lecture on alumino-thermics and their application to engineering and metallurgy.

In the afternoon luncheon was served in the Carnegie Laboratory of Engineering of the institute. The members of the society then inspected the laboratory, shops and draughting-rooms of the institute.

The evening was devoted to a reception of members and guests by the president and president-elect at Sherry's, New York city. The reception was followed by dancing and continued through the evening. The closing session was held at the society's parlors. The professional papers read were: "A Compact Gas Engine, Beam Type;" by Mr. C. H. Morgan; "Standard Unit of Refrigeration," by Mr. J. C. Bertsch; "Series Distilling Apparatus of High Efficiency," by Mr. W. F. M. Goss; "Air Motors and Air Hammers, Apparatus and Methods for Testing," by Max H. Wickhorst; "Valve Motion of Duplex Air Compressors," by Mr. S. H. Bunnell.

Water Powers on the Chippewa River, Wisconsin.

The United States Geological Survey has just completed an investigation of available water powers along the Chippewa river between Chippewa Falls and Flambeau, Wis., and finds that in this distance of about forty-two miles there is a total fall of 243 feet. Only a small part of this is used.

The Chippewa Falls Lumber and Boom Company has a plant at the Falls which develops about one-third of the available 7,000 horse-power. It also has a flooding dam at Holcombe, with a head of eighteen feet. Another company is now at work developing the power at Jim Falls, where there is a head of thirty-three feet. Points at which there are excellent chances for development are Eagle Rapids, with a thirty-foot drop; Brunne Falls, a fine site for a dam, with about the same head, and Point Creek Rapids, Coltons Rapids, and Chevally Rapids, each with five-foot fall.

The field work of the Survey was done by Mr. F. T. Fitch, who made a complete map of the river showing all the islands, rapids and falls, noting at the same time the exact height of the water at the top and the bottom of each fall. Reference marks are left at frequent intervals, by means of which other surveys may be connected to this at any time. The levels upon which the work is based were brought from the gulf of Mexico up the Mississippi river to Reeds Landing, Minn., and thence across to Chippewa Falls.

Electric Light and Power Stations.

The Census Bureau in an elaborate bulletin gives much detailed information in respect to electric light and power stations in the United States at the date of the last census:

At the time of the enumeration there were 3,620 central electric stations in operation. The cost of their construction and equipment amounted to $504,740,352. The gross income for the year was reported at $85,700,605, and the total expenses at $68,081,375. These stations furnished employment to 23,330 wage-earners, who received $14,983,112 as wages during the year.

The power plant equipment consisted of 5,930 steam engines with 1,379,941 indicated horse-power, and 1,390 water-wheels with a stated horse-power of 438,472. The generating plants consisted of 12,484 dynamos of every description with a stated horse-power of 1,624,980. A noteworthy feature of the development of this industry has been the installation of plants operated under the control of municipalities. There were 815 of these plants in operation. The cost of their construction and equipment was reported at $22,020,473. They gave employment to 2,467 wage-earners and paid $1,422,341 in wages.

The 182d Meeting of the American Institute of Electrical Engineers.

The 182d meeting of the American Institute of Electrical Engineers will be held at the Chapter Rooms, Carnegie Hall, 154 West Fifty-seventh street, New York, at 8.15 P. M., Friday, December 18. The following papers will be presented:

"Automatic Apparatus for Regulating Generator and Feeder Potential," by E. J. Bechtel.

"Safeguards and Regulations in the Operation of Overhead Distributing Systems," by W. C. L. Eglin.

"Overhead High-Tension Distributing Systems in Suburban Districts," by George H. Lukes.

"Gas Engines," by J. R. Bibbins.

Reviews of Current Engineering and Scientific Literature.

The Influence of a Magnetic Field Upon the Pitch of Tuning Forks.

In 1885 the Vienna conference decided to use a tuning fork upon a sounding board, and actuated by an electromagnet, in order to obtain a longer period. At the time, attention was called to the fact that the magnetic field might change the pitch of the fork, and some attempts were made by various investigators to detect such an effect. Herr O. Kirstein has made a careful study of this matter, and by using two forks in tune when vibrating freely, he found that they were no longer in tune if one of the forks was actuated by an electromagnet. By selecting two forks not exactly in tune, and observing the beats, and then by changing the period of either one, he was able to determine the effect of the magnetic field. The following are his conclusions. If a tuning fork vibrates in a magnetic field in such a way that the lines of force are perpendicular to the plane of vibration, the pitch of the fork is raised. On the other hand, if the lines of force are parallel to the plane of vibration, the pitch is lowered. The change in pitch is directly proportional to the field strength. The effect of the magnetic field is only temporary. For a given field strength the decrease in the pitch is greater than the increase. If the plane of vibration of the fork lies at forty-five degrees to the lines of force, there is no change in the pitch.—*Translated and abstracted from Physikalische Zeitschrift (Leipsic), November* 15.

Recent Developments in Niagara Power.

In this article Mr. H. W. Buck describes the equipment of the two plants operated by the Niagara Falls Power Company. The old plant, which contains ten 5,000-horse-power units, has reached the limit of its output, and the second plant—which, when completed, will have eleven units of a similar output—is well along toward its limit. This station will be completed by January 1, 1904. The equipment of this station is very similar to that of the first, except that the latest five generators have internal revolving fields, instead of the external fields of the other machines. An allied company is also erecting on the Canadian side a plant very similar in its plans to the American plants, and which will have an output of 110,000 horse-power. The water here is taken from the river through a short canal and forebay, and discharged through penstocks into turbines near the bottom of the wheel-pit. It is carried away to the lower river through a tunnel 1,700 feet long. The size of the units selected for the Canadian power-house is 10,000 horse-power. The dimensions of these machines will not be much greater than those of the 5,000-horse-power machines, so that a considerable saving in the length of the power-house will be effected. Five of these machines will be installed at first. They are wound for three-phase current at 10,000 volts, twenty-five cycles. Power will be transmitted, according to the distance, at 22,000, 40,000 and 60,000 volts. A list of the customers of the company is given, showing the location, the power taken by each, and the distance from the power-house. The author thinks that the Niagara power system will be vastly increased within the next ten years. As these three power-houses will be connected together electrically, there will be almost no danger of interruption to the service. —*Abstracted from Cassier's Magazine (New York), December.*

The Brown-Boveri Parsons Turbo-Generators.

This article gives some data of the Parsons steam turbine sets constructed by Brown, Boveri & Company. These sets are built for outputs varying from 100 kilowatts to 5,000. For a machine of 500 kilowatts or less, the speed is 3,000 revolutions per minute; for 750 and 1,000 kilowatts, the speed is 1,500 revolutions per minute; and for all sizes above these, 1,000 revolutions. The pressure of the steam employed is ten kilogrammes per square centimetre for units rated at 300 kilowatts and under, and twelve kilogrammes per square centimetre for all sizes above this. The temperature of the steam is 250 degrees centigrade and 300 degrees centigrade, respectively. The consumption of steam varies, of course, with the size of the units, but is given at 12.7 kilogrammes per kilowatt-hour at full load, and 15.2 kilogrammes per kilowatt-hour at half load for the 100-kilowatt set. For the 500-kilowatt set the respective figures are 9.1 kilogrammes per kilowatt-hour, and 11.2 kilogrammes per kilowatt-hour. For the 1,500-kilowatt set, the figures are 8 and 9.8 kilogrammes per kilowatt-hour. For the 5,000-kilowatt set, they are 6.6 and 8.35 kilogrammes per kilowatt-hour. The length of the 100-kilowatt machine is 5.6 metres, and the breadth is 0.95 metre. For the 1,000-kilowatt set the length is ten metres, and the breadth is 1.8 metres. The 5,000-kilowatt set is fifteen metres long and 3.5 metres broad. The generator is directly coupled to the turbine without any reducing gear. The frequency of the generator is fifty cycles per second, and they therefore have two, four or six poles, according to the speed. The height of the machines is about equal to the breadth. The weight of a generator set of average speed, including the generator, is about twenty-five to thirty kilogrammes per horse-power.—*Translated and abstracted from L'Électricien (Paris), November* 21.

Cost of Water Power.

It has been estimated by Mr. J. C. Hawkshaw that France uses water power to the extent of 500,000 horse-power. According to Dr. Louis Bell, the total development of improved water power in the United States is 1,500,000 horse-power. Unwin estimates that Norway can supply 236,000 horse-power from large rivers, and that with regulation the quantity could be increased four times. For electrochemical stations alone it is estimated that in 1890 a total of 27,000 horse-power was being used. In addition to this Canada, Africa, India and South America have vast amounts of water power stored for the future. According to Janet, the cost of water power development in France varies from $21.40 to $150 per horse-power, depending upon the head of water, the lowest expenditure being with a fall of 140 metres in Haute-Savoie. At Geneva the first turbines cost $300 per effective horse-power. The subsequent units erected cost but $95 per horse-power, and the completed works will cost but $135 per horse-power. At Vonvray, on the Rhone, the total cost of the first 2,000 horse-power, including water rights, was $160 per horse-power. The second 2,000 horse-power cost only $55 per horse-power. At Lyons the highest capital expenditure amounted to $420 per horse-power developed. In the claret works at Vallorbe, the capital expenditure for a development of 3,000 horse-power amounted to $19.45. The charges for power in Europe vary considerably. In Lyons the yearly rental is $90 per horse-power, and in Switzerland the average rate is only $30 per horse-power per year. At Niagara the charge for electrical energy varies from

two cents per kilowatt-hour for 1,000 kilowatt hours per month or less, to 0.64 cent where the monthly consumption is from 80,000 to 200,000 kilowatt-hours. At Columbus, Ga., electrical power is sold to consumers requiring 1,000 horse-power and over at $15 per horse-power-year, delivered at the secondaries of the transformers, the transformers being furnished by the power company. This energy can be used under contract for sixty-six hours a week.—*Abstracted from the Mechanical Engineer (London), November* 21.

London Underground Electric Railways Power Station at Chelsea.

The present condition of this large power station, which will operate the London Underground Electric Railway Company's systems, and which is located at Lots Road, Chelsea, is here described. The total length of the system is sixty-three miles. The building is 453 feet by 175 feet, and will be 140 feet high. There will be four stacks each nineteen feet internal diameter and 275 feet high. On account of the poor character of the ground, it was necessary to sink the foundations thirty-five feet, and all machinery will be installed upon tall concrete piers. The capacity of the building at normal load is 57,000 kilowatts, being 139 feet per kilowatt, including the office building, and 1.36 square feet per kilowatt. The building is a steel-frame structure sheathed with brick and terra-cotta. The boiler room will contain eighty water-tube boilers arranged two stories high, each having 672 square feet of superheating surface and 5,212 feet of heating surface. The boilers will be piped in groups of eight, each group supplying steam for one electric generating set. There will therefore be ten sets entirely independent. They will be fitted with economizers. The main generating sets will be ten in number, and consist of a horizontal steam turbine running at 1,000 revolutions per minute and driving a three-phase generator at 11,000 volts, thirty-three and one-third cycles. The normal rating for each generator is 5,500 kilowatts, and they will carry an overload of fifty per cent for two hours with practically the same steam consumption. The building is fairly well advanced, as the steel work on October 15 was in place for about half its length up to the roof of the engine room, and to the top of the coal bunkers over the boiler room. Two of the four stacks have reached a height of 150 feet, the other two being only fifty feet up. All the foundations are complete, and the feeder ducts for carrying the cables from the power-house to Earls Court, whence they will diverge to the various substations, are nearly finished.—*Abstracted from the Tramway and Railway World (London), November* 12.

Behavior of a Red Colloidal Gold Solution Toward an Electric Current.

It is generally said that colloidal gold solutions, as well as the permanent suspensions, are coagulated and precipitated by the passage of electric current, red colloidal gold solutions being simultaneously turned blue. Mr. J. C. Blake has investigated the behavior of completely reduced red solution of colloidal gold, formed by the action of an ethereal solution of gold chloride dried at 170 degrees, on acetylene water containing ether. If such a solution is contained in an ordinary beaker, there is no effect apparent upon passing an electric current for hours. This apparent inactivity is attributed to conditions favorable for uniform diffusion. On the other hand, if the solution is contained in an ordinary U-tube, with an electrode in each arm barely entering the liquid in order to avoid the diffusing effect of escaping gases, electrical migration and concentration of the gold may be observed. When contact is made, the gold immediately begins to settle around the cathode with a clear surface of demarcation, leaving a colorless liquid, but never passing the bend of the U-tube. The gold solution around the anode grows deeper in color for about half an hour, and then grows lighter in color, until, after twelve hours, only a faint pink tint remains, all the gold being now concentrated in a red cloud at the bend of the U-tube, except for a slight deposit of dark-colored slime on the anode. When the U-tube is so constructed as to have a long, horizontal portion between the two arms, the phenomena were unchanged, the cloud forming midway between the poles. The red cloud may be diffused by gentle agitation or warming, and diffuses simultaneously when the current is broken. The explanation given is that the gold particles are originally negatively electrified, and hence start toward the anode; but, upon concentrating around the anode, they give up their charges and, receiving a positive charge, are repelled. These positively charged particles meet negatively charged particles migrating from the cathode, and some sort of union is formed, which produces the red cloud at the bottom of the tube.—*Abstracted from the American Journal of Science (New Haven), December.*

Recent Developments in the London Metropolitan Electric Supply Company's Installations.

In this section of this series of articles describing the Metropolitan Supply Company's installations, two of the substations are taken up. The first of these forms part of the Manchester square generating station, and receives power from the Willisden station at 10,000 volts, reducing it to 1,000 volts for working in parallel with the Manchester square plant. The transformers are rated at 100 kilowatts each. The original installation included eight of these. The new additions consist of 2,800 kilowatts in similar transformers and 3,255 kilowatts in motor-generators. This is probably the largest substation in England. The motor-generators are rated at 500 kilowatts each, and the motors are two-phase synchronous machines designed for 1,100 volts, sixty cycles. The generators deliver direct current at from 200 to 230 volts. The machines are built on separate bed-plates, connected together through flexible couplings. A seventy-kilowatt starter set consists of a two-phase induction motor driving direct through a flanged coupling a direct-current generator. The alternating-current switchboard is of the Ferranti standard type, and the board is practically in duplicate, there being two sets of bus-bars, two sets of synchronizing gears, and two pairs of voltmeters. Oil-break switches and fuses are used. The other substation is situated in Tower street, near Seven Dials, and is a motor-generator station from which only direct current is distributed, though alternating current is transmitted thence to the Sardinia street station at times. The transformers used here are of the Berry type, are sixteen in number, and of 100 kilowatts each. They are arranged in groups of three, two and three on each side of the two phases. These transformers have annular horizontal primary and secondary coils, interspersed with one another and interlinked with a number of radially disposed laminated iron systems, leaving abundant surface for cooling by radiation and convection. These transformers supply power to four 500-kilowatt motor-generators—two installed at this station and two at North street. In addition to the motor field regulators, there are two Cowan regulating transformers for the feeders running to the Sardinia street station. Each gives a variation of 120 volts. It is intended to install at this station a storage battery rated at 400 amperes for three hours. These will be supplied with boosters and balancers. The business of the company has increased rapidly, both in supplying lights and power. It leases motors and is encouraging the use of its power for heating and cooking. It will be necessary to install additional machinery to provide for the increased output of the system by next year. —*Abstracted from the Electrical Review (London), November* 20.

The Interstate Independent Telephone Association.

The Third General Meeting, Held at Chicago, Ill., December 8, 9 and 10.

[*Special Telegrams to the Electrical Review.*]

CHICAGO, TUESDAY, DECEMBER 8—The third general meeting of the Interstate Independent Telephone Association was opened at 2 P. M., Tuesday, December 8, at the Auditorium Hotel, Chicago, Ill. A large number of delegates were in attendance, representing telephone men from all of the nine states included in the organization.

President Charles E. Hull called the meeting to order, and introduced Mr. David Levy, who welcomed the delegates on behalf of Mayor Harrison.

A committee was appointed to draft resolutions on the death of Mr. Henry C. Raney, the first president of the association.

President Hull in his address declared that the independent telephone business originated in the needs of those people who were not supplied with telephone communication, and consequently the movement possessed the moral and financial support of the public. This was the secret of past success, and, he thought, the guarantee of future greatness. He suggested, that in order that the organization be successfully maintained, a revision of the constitution was essential, with the object of broadening the field of the organization and placing it on a sound financial basis. He urged the securing of a well-equipped, permanent headquarters, and made a plea for the solidity of the membership and for a general free-will spirit of assistance one with the other. A committee should be appointed to mature plans and to create and foster aggressive sentiment in favor of the independent telephone movement. The question of a distinctive national emblem was raised, and the necessity for this pointed out. Mr. Hull strongly advocated the immediate adoption of some emblem which would be distinctive in its design and meaning.

The secretary's report directed attention to the decision of the manufacturers of telephone and kindred apparatus not to entertain the delegates and guests.

The capital invested in independent exchanges was some $2,000,000, with 2,000,000 subscribers on January 1 of the present year. This was without considering the rural companies, which aggregate a half million more. One hundred and seventy-five cities, with over 20,000 population, have independent exchanges operating. The net earnings of twenty large companies during the last four or five years have been from eight to sixteen per cent. Eight years ago Indiana had 6,000 telephones; to-day there are 80,000 independent telephones in use. Iowa is the banner state, with 1,200 independent companies. There are from 80 to 100 independent companies incorporated each week.

The secretary also pointed out the necessity of the adoption of cooperative plans and alliances, and of legitimate combinations to defeat organized competitors. Capital must be convinced of the possibilities of profit in, and the permanency of, independent enterprises. The secretary stated that there were sufficient funds annually to carry out the plans contemplated in the report, and enabling the employment of competent men to take full charge and develop the various departments. A resolution was passed to refer the secretary's report to a committee of nine, for investigation of the recommendations, this committee to report back to the convention.

A committee of three was appointed to call on the Illinois Telephone and Telegraph Company, for the purpose of inviting Mr. Wheeler, of this company, to address the convention, and ascertain the company's intention regarding connection with outside city exchanges.

Professor W. E. Goldsborough, chief of the Department of Electricity, Louisiana Purchase Exposition, then addressed the meeting briefly with regard to the proposed meeting of the organization next year at St. Louis. P. S. D.

CHICAGO, ILL., Wednesday, December 9—The morning session was devoted to the inspection of exhibits, and a large number of the delegates accepted the invitation of the Illinois Telephone and Telegraph Company to inspect its system.

President Hull called the second session to order at two o'clock. The committee appointed on the previous day to confer with the Illinois Telephone and Telegraph Company, regarding its attitude to independent telephone companies requiring long-distance connection, reported that this matter could not be taken up at present. In the early spring it was expected that cable arrangements would be made so that long-distance connections would be possible with any company proposing, and that was able to furnish good service with metal lines.

Mr. B. F. Wasson, of Clinton, Iowa, addressed the convention regarding a collection of relics of the telephone industry, for an exhibition at the Louisiana Purchase Exposition. He suggested that this collection might be termed an exhibition of the independent telephone interests. Sixty square feet of space was first applied for, but an increase had been found necessary, and an exhibit space of 1,000 feet had been given. This exhibit would unquestionably be interesting, and the association's cooperation was desired. All express expenses would be defrayed for those sending exhibits. A motion to endorse this exhibit was unanimously carried.

Mr. Theodore Gary, of Macon, Mo., addressed the convention regarding the classification of freight rates and the treatment by the railroads of the smaller exchanges. The present dry battery instruments were under the same classification as the old wet battery, and cost four cents apiece from Cleveland to the western portion of Missouri, and three cents to Chicago. On returning empty cells, these were under the wet battery classification, instead of under the regular charter rate. Mr. Gary urged the appointment of a committee to look into this matter. The Missouri railroads demanded free telephone service, and the matter needed adjustment to give the small exchange operator a fair opportunity. After considerable discussion, three committees of three each were appointed—one to take up the question of freight classifications, one to secure paid telephone railroad service, and the other dealing with the express companies.

The committee appointed to act on suggestions and recommendations in the secretary's annual statement, reported that the convention was too short to prepare a permanent constitution and by-laws, and the chairman was authorized to appoint a special committee, consisting of President Hull, Messrs. Cheadle, Moulton and Goodrich, to prepare a suitable constitution, enabling the association to continue until permanent organization was perfected. This committee was to report to the full committee. It was recommended, first,

that the association be incorporated, without capital, profit or liability; second, that the organization cover the present states in the association, with such other states or territories as may be deemed essential to cooperation; third, that the membership fee for operating exchange company, toll line company, individual or corporation, be $5 annually, with an additional tax, according to the character of the exchange; fourth, that contracts for toll line connections be uniform, with also, as far as possible, uniform rates based on telephones in operation.

The committee presented a resolution that a permanent committee, consisting of President Hull and Messrs. Rex, Coleman and Barnhart, be appointed to carry out these recommendations and effect the association organization.

Professor J. C. Kelsey read an interesting paper on "The Standardization of Apparatus," and urged that a committee be appointed by the association, composed of representative engineers of various companies, who would have power to make tests, with a view to the standardization of apparatus and material for all independent companies.

This was followed by a paper written by Mr. W. C. Polk, of Kansas City, Mo., and which was read by the secretary. The subject of this paper was "The Standardization of Construction," and set forth the difficulties of such standardization. The author suggested a national organization board, composed of experienced practical engineers and construction superintendents from all parts of the country, on which investors and operating owners could call for advice, which would be conscientiously and intelligently furnished.

Mr. H. V. Critchfield took the floor, representing President Wheeler of the Illinois Telephone and Telegraph Company. He confirmed the report of the committee, and stated that construction work would be started next spring, with a view to having toll lines radiating in many directions from Chicago.

The meeting adjourned after the committee on credentials recommended that no one be admitted to the future sessions unless possessed of a certificate endorsed by the company he represented.

P. S. D.

CHICAGO, Thursday, December 10—The third session opened promptly at 10 A. M. Several interesting papers were read and discussed. An important topic of discussion was "The Rights of Telephone Companies on Public Highways."

Mr. Henry A. Barnhardt, of Rochester, Ind., read a paper entitled "Where Should the Line of Demarcation Be Drawn between Independent Operating Companies and Manufacturers, and the Bell?" Mr. David Prewitt read a paper on "What Should Be the Representation of Independent Companies in the Association in Voting?" Mr. J. S. Bailey, Jr., Toledo, Ohio, read a paper on "Independent Toll Line Systems, and Is the Time Ripe for Merging?"

Mr. Bailey said that during the past four years the large independent telephone interests in St. Louis, Indianapolis, Cleveland, Pittsburg, Buffalo, Philadelphia, Baltimore, Minneapolis, Kansas City and Chicago have been constructing and equipping long-distance systems with copper circuits to the territory in the vicinity of each of these cities. Up to date the investment had been made of between $15,000,000 and $20,000,000. A number of the above cities representing the square system are connected together by traffic arrangements. He predicted, within two years, the consolidation of these companies, representing by that time capital of not less than $50,000,000 and giving independent long-distance service as extensive as the Bell, and reaching fifty per cent more subscribers in the Western and Middle States. This service, when it comes, would be good to all points instead of to a few.

Mr. Brooks, of Minnesota, directed the attention of the convention to the action of the Postmaster-General, ordering the St. Paul post office to use only Bell service, although the postmaster had found independent service satisfactory. The reason given was that it was nothing political, but for the good of the public required that the company should be used which gave long-distance connection with Washington. This point was made only by eastern cities not possessing independent companies, as Boston, New York and Washington.

W. H. McDonough read a paper entitled "Are Our Telephone Periodicals Careful as to Business Relations Sustained by Contributors."

The following officers were elected:

President, the Hon. H. Barnhart, Rochester, Ind.

Vice-president, E. H. Moulton, Minneapolis.

Secretary, E. M. Coleman, Louisville, Ky.

Treasurer, A. B. Conklin, Aurora, Ill.

Executive Board—Illinois, the Hon. Charles E. Hull; Iowa, J. S. Bellamy; Indiana, O. Rex, chairman; Wisconsin, Richard Valentine; Ohio, W. Guy Jones; Missouri, H. G. Conger; Kentucky, W. Matthews; Kansas, Charles E. Wells; Pennsylvania, J. G. Splane.

Convention adjourned.

The afternoon was passed in visiting exhibits, after which the annual banquet was held, which was very largely attended.

P. S. D.

Parsons Steam Turbines in the United States and Canada.

Mr. George Westinghouse makes the important announcement that for the Westinghouse Machine Company, of Pittsburg, he has acquired from Mr. C. A. Parsons the full rights to manufacture in the United States and Canada the well-known Parsons steam turbines for all purposes, including marine propulsion, and that a special department will be organized at the works for the introduction of this engine in order to more effectively promote its use upon all classes of vessels, including warships of every type. This new department will work in close touch with all the steamship builders in the country.

Mr. Westinghouse when questioned, respecting the matter, said: "The steam turbine is not a new and comparatively untried invention as many laymen seem to think. There are half a million horse-power of Parsons steam turbines in daily operation in different parts of the world; 84,000 horse-power of these are in steam vessels. In the United States alone there are 60,000 horse-power of the stationary type used in connection with electric light and power in continual operation, and 150,000 horse-power more are already contracted for and now under construction at Pittsburg, where units as large as 8,000 horse-power are being built. The impression in the public mind that the steam turbine is a new thing, is probably due to the fact that attention is frequently called to new makes of turbines. The fact is, these new types have not demonstrated any superiority over the Parsons. I have made a broad investigation of this question, with the result that the Parsons turbine is the one with which I have concluded to ally my interest. We shall build up a great marine turbine industry in the United States. The importance of the marine turbine has not been overestimated, and it is long past the stage of experiment. For passenger ships, freight ships, yachts, and for battleships, not less than for torpedo boats, the turbine is unquestionably the best engine. For pleasure craft the turbine surpasses all other forms of engine, because of its absolute freedom from vibration. Its compactness recommends it for all classes of vessels. In torpedo boats the saving of room is needed to accommodate other machinery. In naval cruisers and battleships, the engines lie so much closer to the ship's keel as to make them far less likely to be injured by the enemy's shots. We need not call the turbine the engine of the future; it is decidedly the engine of the present."

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

A Synchronism Indicator.

The accompanying illustrations show a synchronizing indicator manufactured by the General Electric Company, Schenectady, N. Y. Fig. 1 shows the synchronism indicator with pivoted bracket. This indicator, however, is so designed that it can be used with a swinging bracket. Fig. 2 shows the external reactance and resistance used with the synchronism indicator.

This indicator is equally adaptable to single-phase, two-phase or three-phase apparatus. The phase displacement necessary for operation of the instrument is

FIG. 1.—SYNCHRONISM INDICATOR WITH PIVOTED BRACKET.

accomplished by a suitable reactance and resistances mounted in an external cage. These indicators are made for back connections only.

This indicator shows whether the incoming machine is running too fast or too slow, and therefore presents many time-saving possibilities.

The diameter of the dial of the standard instrument is eight inches, thus permitting observation by the operator of the engine or water-wheel, as well as by the switchboard attendant. The construction of the indicator is similar to that of a small motor, the field of which is energized from the synchronizing buses excited by the machine that is running.

The armature is of the drum type,

FIG. 2.—EXTERNAL REACTANCE AND RESISTANCE FOR SYNCHRONISM INDICATOR.

having two coils rigidly fastened at right angles to each other and connected in series.

Both the reactance and resistances are intended to be placed behind the board. The reactance is contained in a metal case, on the outside of which is fastened a socket containing an incandescent lamp, which serves as the resistance. All synchronism indicators are made for 110-volt circuits, unless otherwise specified, but the manufacturer states that they will operate properly on any voltage from 100 to 125.

The words "fast" or "slow" on the dial indicate that the frequency of the electromotive force at the terminals of one ma-

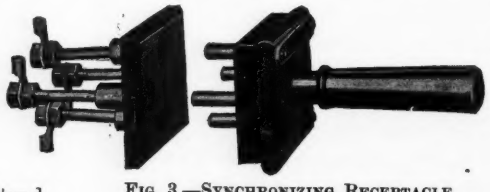


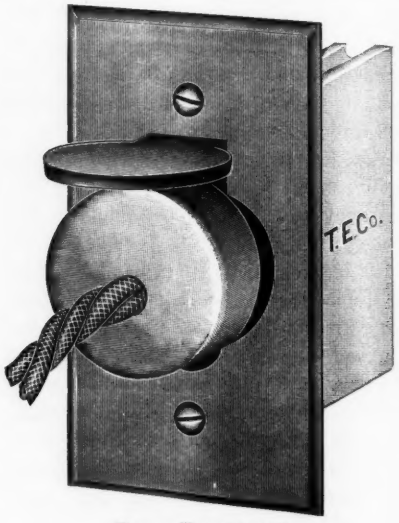
FIG. 3.—SYNCHRONIZING RECEPTACLE AND PLUG.

chine is respectively higher or lower than that on the other—that is, clockwise rotation of the pointer means that the incoming machine is running at too high a speed, counter-clockwise rotation meaning too low a speed.

These indicators are furnished without receptacles, plugs or brackets, unless otherwise ordered. Two styles of plug receptacles are necessary in synchronizing, and three styles of connection plugs are necessary. Fig. 3 is a typical synchronizing receptacle and plug.

A New Flush Receptacle.

The accompanying illustration shows the new flush receptacle made by the Trumbull Electric Manufacturing Company, of Plainville, Ct. The main features of this receptacle are that it fits into any standard switchbox, without the use of a special plug, and that it is made to



FLUSH RECEPTACLE.

take the ordinary Edison base-attaching plug, such as is used for tapping into incandescent lamp fixtures for a fan motor or a desk lamp. This device will be found of great convenience to any one using an Edison plug. When it is not plugged in, the apparatus presents a finished appearance, as it is fitted with a nickel-plated cover which drops smoothly into place.

Special preparations have been made at all of the theatres on the Proctor circuit for an appropriate observance of the Christmas holidays. The electrical features introduced by Mr. Proctor during this period will be of an exceptional nature. He is one of the pioneers in the adaptation of electricity for illumination and spectacular effects in theatricals, and the display during the coming holidays will be of a particularly elaborate nature.

Straight-Bridge Transmitter.

The straight-bridge transmitter shown in the accompanying illustration is one of the products of the telephone department of the Electric Gas Lighting Company, of Boston, Mass.

This company claims that the best skill and the most painstaking effort of its mechanical and engineering departments have been involved in the creation of the Samson transmitter. The front is a heavy brass casting, well nickel-plated, and fitted with a genuine rubber mouthpiece. The main diaphragm is an aluminum disc two and one-half inches in diameter and insulated from the case by a pure rubber band. Dampening springs are used, having rubber terminals of improved design. The company claims to be the first manufacturer to dispense with the use of a heavy bent bridge and to substitute a perfectly flat one which is interchangeable. The construction of the moisture-proof granule chamber is new in design, and it consists of a rigid disc of metal fastened to the diaphragm having a depression in

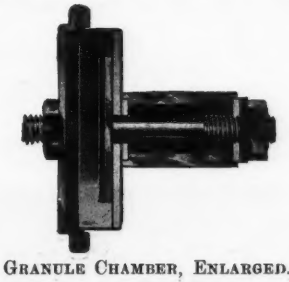
THE TRANSMITTER, THREE INCHES DIAMETER.

which is secured the front electrode of polished carbon. A cup of resilient metal forms the granule chamber and carries the polished carbon back-electrode. It is fastened to the disc by means of a ring and the lugs shown in the illustration. This mode of construction secures the full benefit of the vibratory action of the main diaphragm, and produces a granule chamber which is moisture-proof.

The case in the Samson transmitter forms no part of the circuit. Accidental contact with high-tension outside circuits is therefore avoided. The method of construction and location of the terminals is a new departure in transmitter construction. The connecting screw upon the heavy collar which is insulated from the bridge by mica forms the terminal of the front electrode, while the central post, also insulated by mica from the sleeve which formed a portion of the previous circuit, serves as the other terminal.

Power Plant Accidents.

Within the past thirty years the number of boiler explosions has increased so that many states have passed laws restricting the pressure carried and requiring examinations at frequent periods as a safeguard. During the past twenty years there has developed another factor in the power plant that is even more dangerous,



GRANULE CHAMBER, ENLARGED.

namely, the flywheel break, and records show a considerable loss of life and property from this source. The increase of heavy strains in the exacting duty of street railway, lighting and power work is, in a measure, responsible for this, but in the main the trouble can be traced to a great extent to the same cause as that which produces the boiler explosion—overload.

Whether a flywheel accident insurance

STRAIGHT BRIDGE SHOWING INSULATED TERMINAL.

policy is carried or not, there is another precaution that is becoming more generally recognized all the time by power plant managers and mill owners, namely, the automatic engine-stop, which is a mechanical device operated by electricity. It automatically closes the throttle at any

BACK OF TRANSMITTER.

predetermined overspeed, so that a flywheel can never reach the danger point, and by equipping with this automatic engine-stop, the accident is averted entirely, thus saving lives, destruction of property, and especially saves the loss of business due to shutdown for repairs. This preventative feature is where it surpasses actual insurance, for the latter only remunerates, and that only after the damage is all done.

With engine-stop "insurance," there is only one premium to pay—the first cost of the apparatus—and if the engine races, the engine-stop prevents an accident and no property is destroyed.

On September 10, the Boston *Herald* contained a despatch from New York regarding the discussion of liability underwriters about increasing rates when no engine-stop and speed-limit system is used. To quote the despatch:

"New York, September 9—A number of prominent officials of the liability insurance companies have been discussing informally the advisability of increasing rates upon manufacturing plants, where no engine-stop or speed-limit system is used.

"With the enormous increase in high-speed power the hazard from runaway engines, bursting flywheels, and similar avoidable accidents has become so great that liability underwriters feel that some material advance should be made in order to meet the extra risks. Hardly a day passes that the newspapers do not contain accounts of casualities which might have been avoided had an engine-stop or speed-limit system been installed.

"The liability underwriters argue that if the fire insurance companies can afford to differentiate between 'sprinkled' and 'unsprinkled' risks, the casualty companies should make a like distinction.

"The Consolidated Engine-Stop Company, of 100 Broadway, which controls the Monarch engine-stop and speed-limit system, which has been installed by a large number of progressive manufacturers, has made such a record for accidents avoided, that some of the most prominent liability underwriters have suggested that its use be made compulsory in the same way that certain safety devices are insisted upon by the board of fire underwriters in the installation of an electric plant.

"No definite action has been taken as yet, but it will be formally discussed in the fall."

The Consolidated Engine-Stop Company referred to in the despatch, has lately installed the Monarch engine-stop and speed-limit system in the power stations of the Boston & Northern Street Railway Company; Berkshire Street Railway Company, Pittsfield; Springfield & Eastern Street Railway Company, Palmers; Connecticut Railway and Lighting Company; Edison Electric Illuminating Company, Brockton; Lowell Electric Light Corpora-

tion, Lowell; Malden Electric Company, Malden; Suburban Gas and Electric Company, Revere; Albany & Hudson Railway Company, Albany; Hoosac Valley Street Railway Company, North Adams. It is also equipping large numbers of manufacturing establishments throughout the country.

Electrical Company Reorganizes.

The Fidelity Electric Company, Incorporated, of Lancaster, Pa., formerly the George C. Towle Manufacturing Company, which has lately been reorganized for $50,000 capital, began business in 1896 in the two upper floors of a building, and has been gradually increasing in its product until it now has an extensive system of buildings.

FIG. 1.—INTERIOR OF MACHINE SHOP, FIDELITY ELECTRIC COMPANY, LANCASTER, PA.

The company began as manufacturers of fan motors exclusively, then added a line of small power motors and generators, which it has gradually increased in capacity. Fig. 1 shows the interior of part of the machine shop, which is equipped with modern tools. The total floor space of its buildings is 12,000 square feet.

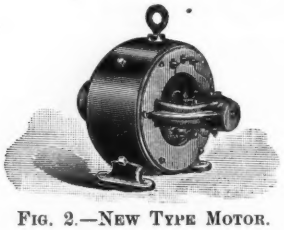


FIG. 2.—NEW TYPE MOTOR.

Among the latest types of motors is its type "P," shown in Fig. 2, built from one-sixteenth to ten horse-power, which recommends itself on account of its adaptability for back gearing, or for inverting for ceiling suspension. The motors are all multipolar and of moderate speed. The body castings are of cast steel, of the highest permeability, the body being cast in one piece.

The field coils are form wound and dipped in a special insulating compound and are wrapped with varnished linen before being taped.

The armature is barrel wound, and is of the ventilated type; air ducts being provided from the interior of the core to the exterior.

The commutators are constructed of drop forged bars and the washers and core of carbon steel to withstand the strain of drawing up in course of construction.

The sliding bases in the larger sizes are parallel machined sliding bars, and in the smaller, the now almost universally used platform base.

The officers of the new company are C. F. Stauffer, president; B. G. Stauffer, treasurer and general manager, and M. S. Graver, secretary.

An Automatic Time Switch.

The Hartford time switch, shown in the accompanying illustration, automatically opens and closes an electric circuit at any predetermined time. When the automatic use of the switch is not desired, it can be instantly disconnected from the clock, when the hand trip provides an independent means for operating the switch.

The time for automatically operating the switch can be quickly and easily changed. The eight-day Seth Thomas clock, which is used with this switch, ensures absolute accuracy in time and certainty in operation.

The switch is of the rotary, double-contact type, with quick break of approved length. The operation is entirely mechanical and no magnets are used.

By a special attachment the switch can be arranged to light show windows or signs for two periods each night.

Thorough and long tests in service have fully demonstrated the accuracy, durability and practicability of this switch under all climatic conditions and varying temperatures.

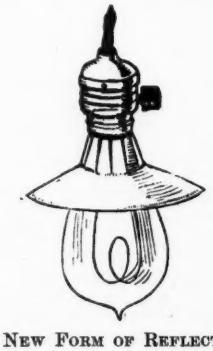
AUTOMATIC TIME SWITCH.

This apparatus is made in three sizes, ten, twenty and thirty amperes, any voltage up to 250, for alternating or direct current, by the Hartford Time Switch Company, Hartford, Ct.

A New Form of Reflector.

The Pardridge Shade and Reflector Company, 183 and 185 Dearborn street, Chicago, Ill., has placed on the market a reflector for incandescent lamps which is meeting with the approval of supply men all over the country.

This reflector can be adjusted to fit any incandescent lamp of any candle-power or base. It is four inches in diameter, one and three-eighths inches high, and is made of brass, heavily nickel-plated and highly polished on the inside. The device is fitted with a small ring attachment that prevents the metal spring of the reflector from coming in contact with the metal of the socket. This avoids any possibility of a short-circuit.



A NEW FORM OF REFLECTOR.

For decorative purposes, the reflector is furnished in colors—green, red, blue, and yellow.

Interests Represented at the Convention of the Interstate Independent Telephone Association.

Kellogg Switchboard and Supply Company—W. W. Dean, A. E. Balke, R. H. Madison, F. J. Dommerque, R. S. Mueller, W. A. Lutz, Paul Bossert, A. B. Kratz, H. Klein and W. R. Hind.

Automatic Electric Company—H. D. Critchfield, J. F. Cook, H. S. Durant, H. D. Ogden, W. E. Cooke and F. L. Lucia.

The Central Telephone and Electric Company—J. S. Cumming, C. H. Wallis and W. F. Gradoulph.

Standard Underground Cable Company—J. R. Wiley, E. J. Peitzcher, W. M. Rogers and A. A. Anderson.

F. B. Badt & Company—F. B. Badt and G. M. Willis.

Williams-Abbott Electric Company—L. Sands.

Chicago Telephone and Supply Company—G. A. Briggs and R. L. McCoy.

American Conduit Company—John R. Cravens and W. J. Barrett.

Crouse-Hinds Electric Company—F. S. Skeel.

Moon Manufacturing Company—F. H. Wood and H. E. Procunal.

National Wire Corporation—R. B. Abbott.

Kaster Electric Manufacturing Company—A. J. Witherell and F. G. Vickeoson.

McRoy Clay Works—E. F. Kirkpatrick.

Illinois Electric Company—M. McNeil, C. J. Litschel and C. L. Pierce.

F. Bissell Company—M. S. Walker, E. B. Terry and W. S. Bissell.

Sterling Electric Company—W. E. Doolittle, H. A. Taylor, S. B. Fowler, H. S. Bullock, H. T. Doolittle, Evan Shelby, K. V. Murry and G. W. Metcalfe.

W. J. Ball Manufacturing Company—W. J. Ball and L. G. Le Baurveau.

Fulmer-Kuester-Schroeder Company—J. W. Fulmer, D. M. Fulmer and H. C. Miller.

W. H. Anderson & Sons—W. R. Anderson and Thomas Tapp.

Raber & Watson—A. D. Watson and P. E. Raber.

American Carbon and Battery Company—T. P. Gleeson.

Chicago Writing Machine Company—R. E. Hill, F. W. Pardee and S. J. Siegfried.

New Haven Novelty and Machine Company—H. G. Thompson and Charles Luke.

Warner Electric Company—T. W. Warner.

Indiana Steel and Wire Company—Robert Miller.

Western Telephone Manufacturing Company—J. E. Keelyn, W. G. Peacock and E. Schwartz.

Maltby Lumber Company—E. E. Reynolds.

The Allen-Hussey Company—C. J. Huff.

Miller Anchor Company—C. H. Miller and F. B. Miller.

Crawfordsville Wire and Nail Company—Robert Schweitzer and H. E. Cobb.

Electrose Manufacturing Company—H. E. Cobb.

American Stone Conduit Company—George Painter.

Chicago Nut Company—C. F. Messinger.

National Carbon Company—F. H. Murray, M. H. Moffett and A. V. Ward.

Frank B. Cook—Frank B. Cook, J. A. Cook, H. R. Cook, J. F. Thompkins, C. E. White and F. A. Parker.

Vesta Storage Battery Company—

Monarch Telephone Manufacturing Company—W. H. Trimm, E. E. Yaxley and J. C. Hubacher.

American Electric Fuse Company—F. H. Jones.

Gordon Battery Company—E. M. Deems.

Elmore-Fowler-Jacobs Company—J. H. Fowler and Ellinge Elmore.

Western Lumber and Pole Company—B. F. Vreeland.

North Electric Company—Charles H. North, F. F. Sapp, R. Hendrickson and F. Pratt.

Chicago Insulated Wire Company—W. M. Smith.

American Electrical Works—Francis E. Donohoe.

Gould Storage Battery Company—E. L. Drappen.

American Circular Loom Company—T. G. Grier.

H. B. Camp Company—J. A. Hammett.

C. L. Pierce, Jr.

Wesco Supply Company—J. W. Hardy.

Lindsley Brothers—E. A. Lindsley, secretary.

Baker Engine Company—Ellis B. Baker.

Okonite Company—George T. Manson.

Signal Phone Company—R. B. Rogers and E. E. Salisbury.

Eureka Electric Company—I. J. Kusel, V. Rosenow, H. G. Kusel, H. W. Foote and R. Mitten.

Nungesser Electric Battery Company—H. G. Rogers and Thomas Grier.

Hipwell Manufacturing Company—H. H. Hipwell.

American Electric Telephone Company—J. G. Ihmsen, P. C. Burns and H. P. Clausen.

John A. Roebling's Sons Company—W. W. Alfesk, George C. Bailey, W. H. Slingluff and G. W. Swan.

Ewing-Merkle Electric Company—William G. Brown.

Nicholas Selector Company—W. G. Rich, C. A. Rich and C. E. Nicholas.

Annual Meeting of the Electrical Trades Society.

The eighth annual meeting of the Electrical Trades Society, of New York, was held at Muschenheim's Arena, New York city, on Tuesday evening, December 8. The business meeting began shortly after six o'clock, and adjourned at 7.30 for dinner. The attendance was quite large, and a number of visitors from other societies were in attendance. The reports of the officers were very gratifying, and showed that the society was in a very healthy condition, and increasing in membership and importance.

The board of directors were elected for the ensuing year, as follows: H. A. Reed, J. H. Dale, R. E. Gallaher, J. P. Marshall, J. J. Gorman, F. V. Bennis and H. R. Swartz.

New York Electrical Society.

The 239th meeting of the New York Electrical Society will be held at the American Institute, 19 West Forty-fourth street, New York city, Wednesday, December 16, at 8 P. M.

The subject of the evening will be "The Evolution of the Electric Railway Motor," by Mr. S. T. Dodd, of the Stanley Electric Manufacturing Company, Pittsfield, Mass. The lecture will be freely illustrated by lantern slides.

BOOK REVIEWS.

"Whittaker's Electrical Engineers' Pocketbook." Edited by Kenelm Edgecumbe. New York. The Macmillan Company.*

*In the issue of the ELECTRICAL REVIEW for November 21, 1903, the price of this book was given as $1. The publishers have since informed us that this should have been $1.75, and regret that this error (on their part) was made.

"Cours d'Électricité." Vol. ii. H. Pellat. Paris. Gauthier-Villars, Imprimeur-Libraire. Paper. 6½ by 10 inches. 554 pages. Supplied by the ELECTRICAL REVIEW at $4.

These books have been prepared by the author for use in the course of the Faculty of Sciences, Paris. Vol. i considered electrostatic, Ohm's law, thermoelectricity; and the present volume takes up electrodynamics, magnetism, induction and electrical measurements. The ground is covered very thoroughly, and without an excessive use of mathematical demonstrations.

"Electric Toy Making." Fifteenth edition. T. O'Conor Sloane. New York. Norman W. Henley & Company. Cloth. 183 pages. 5 by 7 inches. Numerous illustrations. Supplied by the ELECTRICAL REVIEW at $1.

This little book describes the simpler forms of electrical apparatus with which an amateur is most likely to be supplied. It gives instructions for constructing electromagnets, and several simpler forms of electric motors, as well as some ingenious toys. Instructions are given for constructing simpler telephone and telegraph instruments, and a number of pretty and interesting experiments is described.

"Arithmetic of Electricity." Sixteenth edition. T. O'Conor Sloane, New York. Norman W. Henley & Company. Cloth. 162 pages. 5 by 7 inches. Diagrams. Supplied by the ELECTRICAL REVIEW at $1.

This book is a practical treatise on electrical calculations of all kinds, reduced to a series of rules, involving only ordinary arithmetical operations. Each rule is illustrated by one or more problems, showing the application and assisting greatly in making the method clear. It should be a valuable book to the practical man, and especially to those who can not use algebra and the higher mathematical processes.

"Wireless Telegraphy." Charles Henry Sewall. New York. D. Van Nostrand Company. Cloth. 229 pages. 5½ by 8½ inches. Many illustrations and diagrams. Supplied by the ELECTRICAL REVIEW at $2.

This work is marked by conciseness of text, logical and instructive arrangement of matter, and clearness of illustration. Inventors and inventions named have been discriminatingly treated, and their work described with a restraint that indicates a mastery of the subject. A feature of merit is the chapter on receiving devices, containing many not generally known. Another is the discussion of the comparative merits of wireless and wire telegraphy, in the course of which the backwardness of American telegraph companies to adopt improved methods of transmission is made very plain. It is cleverly indicated that the commercial future of wireless will have a strong competitor in the existing wire lines under their use with systems of rapid telegraphy already practically perfected. The reader is given the impression—in the reviewer's opinion, a just one—that the achievements of space telegraphy so far would make us feel ashamed of our primitive use of a wire line, capable as it is of bearing electric waves with a facility that makes emission of signals from a vertical wire seem difficult indeed by comparison. The quantity of matter warrants a fuller index, and the book might legitimately have been enlarged both in matter and in contemporary value by a fuller expression of the author's running comments. There is undue condensation of the theoretical part: if the history and nature of Hertz waves were elaborated more, the admirable conciseness of descriptions of different systems would be better appreciated. The omission of some matters, perhaps of too recent occurrence to be included, is to be regretted. The work of Tesla is given considerable attention. The Stone system, constituting what is probably the most scientific treatment of genuine tuning, and the most recent work of Lodge and Muirhead, are not referred to in the book. The chief fault, however, is that one wishes there was more of it. It is to be hoped that future editions will remedy this defect. At any rate, the present edition can not be omitted from any collection of works on wireless telegraphy.

"The Electrical Engineer's Pocketbook." Horatio A. Foster. New York. D. Van Nostrand Company. Flexible leather. 1,000 pages. 4¼ by 6¾ inches. Numerous illustrations. Supplied by the ELECTRICAL REVIEW at $5.

This is the third corrected edition of an already popular handbook. The several departments have been revised by specialists in each line, and the whole work has been carefully prepared by the author in collaboration with a number of eminent professional men. There are numerous tables, and the formulæ are not only given, but the manner in which these are derived is also shown. Accurate descriptions of measuring instrument tests are given, and a short treatise is accorded to each piece of apparatus. The tables of dimensions and constants are accurately worked out, and are so arranged as to afford easy reference. Every method described in this handbook is carefully illustrated, and practical examples are given showing the use of the formulæ. The book has been brought up to date, and affords the engineer the most modern conclusions of experimenter and designer. It will not only be valuable to the electrical engineer, but the information is so complete that the mechanical and the civil engineer will also find the book of great practical value.

Wireless Telegraphy Notes.

The London *Times,* of November 10, states that during Marconi's voyage to Gibraltar, on H. M. S. Duncan, messages were received on board daily after the vessel left Portsmouth. During rough weather one of the special wireless gaffs was carried away, but, notwithstanding that this reduced considerably the height of the masthead wires, the reception of the messages on board continued in an uninterrupted manner. During the several days' stop at Gibraltar, tests were carried out with the object of ascertaining the relative efficiencies of different forms and arrangements of aerial wires. Messages were always received from England with regularity when the arrangement which Mr. Marconi had anticipated would be necessary for the purpose was used. These messages passed across the whole of Spain. It seems that messages could not be sent from Gibraltar to Poldhu with the apparatus on the ship.

It is reported that a large wireless telegraph station is being constructed at Bari. The station will be able to communicate with other stations established along the Italian coast, with vessels in the Adriatic, and the Montenegran station at Antivari. The wireless telegraph stations at Maddalena, Monte Mario, near Rome, Palmaria, Cozzo and Spadafora, Italy, are already working. The first two are exclusively for military purposes; the others will be open to the public. The site for another powerful Italian station has been chosen at San Rassone. It is said that this station will be able to communicate with Argentina and with the stations at Table Head, Cape Cod and Poldhu. A new Marconi station has been commenced at Fraserburgh, on the Aberdeenshire coast, for the purpose of testing the large power stations overland.

The report of the Indian Telegraph Department (India) states that wireless telegraphy has been established between Sangor Island and the Sandheads, and difficulty is encountered only during thunder-storms.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

TELEPHONE COMPANY NOT TO APPEAL—It has been decided by the American Telephone and Telegraph Company not to ask for a rehearing before the United States Court of Appeals in the Western Union-Bell Telephone royalty case, which was decided in favor of the telegraph company on October 7 last. Counsel for the telephone company has notified counsel of the Western Union Telegraph Company to this effect. The telephone company had thirty days in which to petition for a rehearing, which was extended to December 4. The next step in the case will be the appointment of an auditor by the court to determine the payment to be made by the telephone company, or a petition for a writ of certiorari for a hearing before the Supreme Court.

EXTENSIVE IMPROVEMENTS AT DURBAN, SOUTH AFRICA—About $14,000,000 is the estimated cost for the projected port improvements at Durban, South Africa. For the construction of three-story wharf sheds about $250,000 will be expended. A customs and bonded warehouse will cost some $250,000. Cranes and other machinery will entail an expenditure of nearly $60,000. For extensions to the hydraulic system $125,000 has been allotted. The expenditure of about $100,000 will be incurred for the equipment of new workshops. Additions to the electric lighting and power plants will mean an expense of about $125,000. The installation of mechanical coaling facilities is also provided for. Sir Wolfe Barry, of London, is one of the chief consulting engineers for the Durban improvements.

ENGLISH CAPITAL MAY CONTROL MORE MEXICAN POWER SCHEMES—Negotiations looking to Canadian interests taking over and enlarging the electric lighting and power system at Puebla, one of the larger Mexican cities, have been broken off. A. E. Worswick, formerly chief engineer of the Mexico City electric traction system, who has an option on the Puebla plants, has gone to Europe, and is understood to be negotiating with the London financial house of Wernher Beit & Company, which controls the Mexico City system, to purchase the Puebla plants. The Pazuelo Electric Light and Power Company is the name of the concern which furnishes power to Puebla. It operates a 4,000-horse-power hydraulic plant. Should the deal go through the horse lines in the same city are likely to be converted into electricity and extended. The existing tramways are about twenty miles long.

PROPOSED MEXICAN TRACTION SYSTEM—Guadalajara, one of the most prosperous cities located in western Mexico, is to have an extensive electric traction system. A company styled La Electra Sa was recently organized in Mexico for the purpose of taking over the horse car lines—about thirty miles in length—and acquiring the Compania de Luz Electrica de Guadalajara, which electrically lights the city, power being derived from a 2,500-horse-power water plant. In addition to several cars, etc., the equipment for a new power station will be purchased. This plant will have an initial capacity of 1,500 horse-power and will furnish energy for operating the proposed new traction system. The power station will be located on the Rio Grande, at a point about two miles distant from Guadalajara. C. A. Malau, the consulting engineer for La Electra, is now engaged in drawing up plans for the conversion and extension of the lines and for the new power-house. American equipment, machinery, etc., will be purchased.

CAN NOT BUILD OPEN SLOT SYSTEM BECAUSE OF TIDES—Dock Commissioner Hawkes has announced that he had been notified by representatives of the New York City Street Railway, succeeding the Interurban, that the engineers of the road had forwarded to him a report of their investigations concerning the proposed running of an overhead trolley road down West street, New York city, to replace the present horse car belt line. The conclusion of the engineers is that any but an overhead trolley line is wholly impracticable on the street from Tenth street down owing to the high tides, which, they report, would render dangerous and valueless an underground trolley system there. It is the desire of the road to replace the horse car belt line with convertible cars, which can be used as underground trolley cars above Tenth street and as overhead trolley cars below that line, and it seeks the consent of the dock commissioner, who has the power to grant the consent of the city as the property owner along the entire west side of West street, that side of the street consisting of piers and bulkheads owned by the municipality.

CONNECTICUT TROLLEY REPORTS—The following street railway companies which are controlled by Boston capitalists have filed their annual reports with the railroad commissioners. The Norwich Street Railway Company reports that its operating expenses were $71,990, and its net earnings were $43,539; surplus, $7,672. It carried 2,641,058 passengers. The Montville Street Railway Company reports that its operating expenses were $51,249, and its net earnings $43,866; surplus, $11,355. The number of passengers carried was 1,583,626. The New London Street Railway Company states that its operating expenses aggregated $47,907, while its net earnings amounted to $22,936; deficit, $499. It carried 1,535,279 passengers. The Somers & Enfield Electric Company states that its operating expenses were $7,473, and its net earnings $4,691; surplus, $3,941. It carried 250,501 passengers. The three trolley companies owned by the New York, New Haven & Hartford Railroad Company have filed their reports as follows: the Worcester & Connecticut Eastern Railway Company reports that its operating expenses were $100,373, and its net earnings $26,823; surplus, $117,517. It carried 2,464,000 passengers. The Meriden Electric Company reports that its operating expenses were $94,588, and its net earnings, $54,880; surplus, $15,601. It carried 3,470,480 passengers. The Stamford Street Railroad Company announces that its operating expenses were $55,411, while its net earnings were $27,542; deficit, $15,956. It carried 2,101,304 passengers. The Fair Haven & Westville Railroad Company, which represents New Haven's trolley system, reports that its gross earnings were $1,013,542; its operating expenses, $642,962; net earnings, $370,580; surplus, $4,264. It carried 25,804,187 passengers. The Danbury & Bethel Street Railway Company reports that its operating expenses were $61,072, and its net earnings were $19,831; deficit, $3,383. The number of passengers carried during the year was 2,001,790. The Torrington & Winchester Street Railway Company states that its operating expenses amounted to $30,341, while its net earnings aggregate $20,552; deficit, $14,099. It carried 1,030,460 passengers. The Greenwich Tramway Company reports operating expenses of $28,151, and net earnings of $18,267; surplus, $18,077. It carried 928,384 passengers. The Middletown Street Railway Company states that its operating expenses were $31,683, and its net earnings, $10,267; deficit, $156. It carried 1,000,923 passengers.

LEGAL NOTE.

INSULATING ELECTRIC WIRES—A company furnishing electric power, the Supreme Court of Arizona holds, in the case of Phœnix Light and Fuel Company *vs.* Bennett (74 Pacific Reporter 48), is not guilty of negligence because in carrying its wires into a building it fails to insulate against electricity having its origin in the clouds or atmosphere. "An essential ingredient to any conception of negligence," says the court, "is that it involves the violation of some legal duty which one person owes another—a duty to take care for the safety of the person or property of the other. This duty may be assumed by contract, or it may be imposed by implication of law. Where a person, proceeding in a lawful business, exercises a reasonable care, the law does not make him an insurer against those consequences of his actions which reasonable care and foresight could not have prevented. The law justly ascribes such consequences to inevitable misfortune or to 'the act of God,' and leaves the harm resulting from them to be borne by him on whom it falls." If the electric light company, the court concludes, insulated the wires in such a way as to protect the house against injury from the ordinary current carried on those wires, it did all that it could be required to do. Its duty did not call for the insulation of the wires "in a manner to protect against injurious consequences of a lightning stroke, for the evidence shows that it was not practicable to insulate them against lightning, and there is nothing in the record which indicates any assumed or implied obligation of this character."

TELEPHONE AND TELEGRAPH.

DRYDEN, N. Y.—The Home Telephone Company has opened an exchange at Marathon.

ROCHESTER, N. H.—A telephone line is to be installed from this city to Barrington.

CEDAR FALLS, IOWA—The Boone County and Ogden Telephone companies have been merged.

GREENFIELD, MASS.—A suburban telephone line is being installed connecting Orange and North New Salem.

WESTLAND, PA.—The people of Westland are said to be contemplating the installation of a telephone system.

ERIE, PA.—The Mutual Telephone Company's stockholders have agreed to increase the capital stock from $75,000 to $150,000.

NEW YORK, N. Y.—The Baiting Hollow and Roanoke Telephone Company will increase its capital to $20,000.

NEWARK, N. J.—The Merchants and Farmers' Telephone Company has secured the right of way to Three Bridges, and will extend its lines to that place.

MUSKEGON, MICH.—The Oceana Telephone Company will increase its capital $200,000 and change the name of the company to the Lake Shore Telephone Company.

JACKSON, MICH.—The Valley Telephone Company has established a circuit from Saginaw to Frankenmuth, and has also built a pole line from Saginaw to Caro, with a branch to Vassar.

MANCHESTER, N. Y.—The Red Jacket Telephone Company is extending its lines through the town of Farmington, using the poles of the Interocean Telephone Company, with wires on a separate arm.

KNOXVILLE, TENN.—The American Telephone and Telegraph Company has completed its line through Knoxville from North Carolina to Harriman, and is now building a line from Chattanooga to Lexington, Ky.

TROY, N. Y.—The Eastern New York Telephone and Telegraph Company has reelected these directors for the ensuing year: Watson M. Holmes, C. B. Story, G. Frank Rising, L. E. Worden, Francis Riley and Louis Haussler.

CHARLOTTE, N. C.—It is learned that the Seaboard Air Line Railway is now making preparations to install a complete telephone system over its lines in this section and the south, utilizing the telegraph wires for transmitting the electrical current.

YOUNGSTOWN, OHIO—The Beaver Telephone Company, it is stated, will extend its system to New Springfield. The company now has connection with the Columbiana Telephone Company on the south and the Youngstown Telephone Company on the north.

ST. LOUIS, MO.—The cable which will connect the Illinois lines of the Pike County Telephone Company with the Missouri lines of the Bluff City Telephone Company, at Hannibal, has been laid in the Mississippi river at Hannibal. The cable is over 3,000 feet long.

SIOUX CITY, IOWA—The Sioux City Telephone Company announces that it will spend $350,000 to establish its plant here. Its exchange building will be a three-story fireproof structure, and the equipment will be of the latest type. Poles will be set this winter, and wires and cables are to be strung before spring. The underground work will not be started before next April.

DUBUQUE, IOWA—The city council has adopted the ordinance asked for by the Iowa Telephone Company. By the terms of the ordinance all telephone companies operating in the city must place their wires underground. The Iowa company will expend about $140,000 on its system within the next twelve months. A new building, to be devoted exclusively to telephone purposes, will be erected.

LAKE CITY, MICH.—A deal has been consummated by which the Swaverly Telephone Company, of Kalkaska, parts with all its toll lines in Missaukee County. The purchasers are all Missaukee County people, chiefly those who first installed the lines. The lines extend from Manton to Lake City, and from Lake City to Moorestown, in all about thirty-five miles, with a dozen or more substations. Many improvements are under consideration for the lines.

ABERDEEN, S. D.—The Dakota Central Telephone Company has closed contracts for the material necessary for its contemplated extensions, aggregating $150,000. The company has made traffic arrangements with the lines running from the southern part of the state into Iowa and Minnesota, and the new lines to be built will be for through business to connect Aberdeen, Huron, Mitchell, Pierre, Madison, Sioux Falls and other important cities, as well as intermediate points, with Sioux City and other cities of Iowa and southern Minnesota.

ALBANY, N. Y.—The North Shore Telephone Company has been incorporated to carry on operations over the following route: through the towns of Riverhead, Brookhaven, Smithtown and Huntington, Suffolk County. The points to be connected are the villages of Riverhead, Port Jefferson, Smithtown, Northport and Huntington. The capital stock is placed at $7,500, and the directors of the company for the first year are Ralph J. Hawkins, J. E. Overton, J. H. Davis and Charles V. Platt, of Port Jefferson; A. B. Copley, of Stony Brook; Frank H. Tuthill, of Rocky Point; Charles A. Squires, of Echo, and William A. Davis, of Mount Sinai.

PERSONAL MENTION.

MR. G. F. STILES has resigned as chief electrician of the Atchison, Topeka & Santa Fe Railway Company.

MR. CHARLES H. HIVES has been appointed electrical engineer of the Canadian Pacific Railroad, with headquarters at Montreal, Canada.

MR. R. H. SOULE, mechanical engineer, has opened an office at 29 West Thirty-fourth street, New York city, as consulting and designing engineer.

MR. GEO. A. McKINLOCK, president of the Central Electric Company, Chicago, is spending a few days in New York, accompanied by Mrs. McKinlock.

MR. W. W. DEAN is now chief engineer of the Kellogg Switchboard and Supply Company, of Chicago, Ill., in full charge of the laboratory and all exchange work.

MR. N. H. HOLLAND, the well-known telephone engineer, has resigned from the Couch & Seeley Company, and is now with the Holtzer-Cabot Electric Company, at Brookline, Mass.

LIEUTENANT ROBERT E. PERRY, C. E., U. S. N., has returned from a six weeks' trip to England and Germany, where he has been for the purpose of inspecting naval barracks as constructed in those countries.

MR. F. E. ROTCHKA, formerly sales manager of the Sterling Electric Company, Lafayette, Ind., has recently associated himself with the Stromberg-Carlson Telephone Manufacturing Company, and is now connected with the Chicago office of this company.

MR. W. E. WILLIAMS, B. Sc., of the University College of North Wales, has been elected a fellow of the University of Wales for 1904. He proposes as his subject of investigation, to be carried on at Glasgow University, "The Effect of Magnetization on the Electrical Properties of Nickel Steel."

MR. A. GIDEON, civil engineer, attached to the War Department, is now in San Francisco, Cal., en route for the Philippines. Mr. Gideon was one of the engineers who designed the sewer system for the city of Havana. He will be connected with the installation of the new system in the city of Manila while in the Philippines.

MR. H. F. J. PORTER, who has been associated with the Westinghouse interests since the first of the year, as the assistant manager of the publishing department, has been selected as second vice-president of the Nernst Lamp Company, with the duties of general manager, with headquarters at Pittsburg. Mr. Porter assumed charge on December 1.

MR. L. E. SPERRY, who was a foreign representative of the Western Electric Company for several years, with headquarters in Japan, has assumed the management of the California Electrical Works, which is the Pacific agency of the Western Electric Company. Mr. Salt, the former manager, has gone to New York, where he will hereafter be connected with the Western Electric Company at that place.

MR. FRANK MARTIN, who for several years has been in charge of the electrical department of yards and docks at the Brooklyn Navy Yard, has tendered his resignation in order to take charge of the University Power Company, Princeton, N. J., which has just installed a large plant for supplying light, heat and power to the citizens of Princeton. The company's customers include the Princeton University. Prior to his work at the Navy Yard, Mr. Martin was connected with the Edison Electric Illuminating Company, New York.

MR. FRANK C. McCONNELL, of Youngstown, Ohio, has been appointed manager of the Northern Ohio district of the Central

Union Telephone Company, with headquarters in Akron. Mr. McConnell took up his new duties December 1. He is well and favorably known in telephone circles, having had a wide experience in the business. Akron will be the headquarters of the district, which will extend from Mansfield on the south to Norwalk on the west, the eastern and northern limits being the state line and Lake Erie, respectively.

MR. ELIAS E. REIS, electrical engineer and patent expert, 116 Nassau street, New York city, has written a lengthy letter to Mr. McDougall Hawkes, dock commissioner of New York city, with regard to the equipping of West street, New York city, with an electric traction system. Considerable comment has recently been caused by reason of the adverse reports of the engineers with regard to an electric traction system of the open-slot type. This is due to the adverse conditions which are well known in that vicinity, because of the high tides which prevail at frequent periods, inundating the underground section of that quarter. Mr. Reis suggests the use of a combination or mixed system which he invented some years ago, and which has been in successful operation both in the United States and abroad. This system consists of carrying a set of lightweight batteries for the short run which will be necessary, in addition to the regulation plows which would enter the slot of the conduit system.

MR. THOMAS W. VARLEY has resigned as engineer of the testing department of the New York Edison Company, to accept a position with the Boston, Mass., branch of the Westinghouse Electric and Manufacturing Company. On the evening of Saturday, December 5, Mr. Varley was given a dinner at the Café Martin by a number of old-time friends and associates of the New York Edison Company. Among those present were Mr. W. H. Lawrence, Mr. A. H. Ackerman, Mr. W. J. Chisholm, Mr. Frank Martin and Mr. Edward Durant. Mr. Varley is a comparatively young man in the profession, and has been successful to a considerable degree. He is the inventor of the Varley ground detector, which enables the location of faults on high-tension circuits while the cable is in service. His latest invention is the Varley rotating voltmeter, which gives a true reading while the meter is near a large generator where magnetic disturbances are liable to be a maximum. Mr. Varley is a brother of Mr. Richard Varley, of Providence, R. I., the well-known expert on electromagnets.

ELECTRICAL SECURITIES.

The rally in prices last week, while apparently encouraging, is viewed in many quarters with distrust, as there seem to be evidences that this is artificial, and will not prove stable under aggressive bear manipulation. However, the developments intensified the general confidence in the outlook that the market had been turned, and, notwithstanding the discouraging sentiment mentioned above, there is considerable hope that the higher prices will be maintained. The industrial outlook is said to be improving, and while this is coincident with the rise in prices, rather than a part of it, the idea is prevalent that it may have a good deal to do in shaping further improvements.

The electrical securities, particularly Brooklyn Rapid Transit, led in the rally of prices, and it seems entirely possible that these stocks will be the chief feature for some time.

The report of the managers of the Westinghouse Electric and Manufacturing Company is to the effect that fully as much business is expected in 1904 as has been the case in 1903, and this is not without importance as a factor in maintaining faith in electrical securities.

Call rates for money have gone as high as nine per cent, with six and one-half and seven per cent the average for the business of the week.

ELECTRICAL SECURITIES FOR THE WEEK ENDING DECEMBER 5.

New York:	*Closing.*
Brooklyn Rapid Transit	48⅛
Consolidated Gas	178
General Electric	160
Kings County Electric	175
Manhattan Elevated	141¼
Metropolitan Street Railway	120
New York & New Jersey Telephone	145
Westinghouse Manufacturing Company	185

A quarterly dividend of 2 per cent will be paid January 2, 1904, to stockholders of record of the Commercial Cable Company on December 19, 1903. The transfer books will be closed December 19, 1903, and reopened January 4, 1904.

The quarterly report of the Interurban Railway system has been forwarded to the State Railroad Commissioners. The report gives the aggregate earnings of the twelve separate properties embraced in the system, and is the first report of the kind which has been made, the earnings of the properties having been treated separately in previous reports. For the quarter ended September 30, 1903, the gross earnings of the company amounted to $5,570,212.03, and the operating expenses to $2,761,600.40, leaving net earnings of $2,808,611.63, as compared with $2,635,668.44 for the same quarter of the preceding year, an increase of $172,943.19. Income from other sources amounted to $370,224.65, bringing the total income up to $3,178,836.28. Subtracting deductions from income, which amounted to $3,015,459.63, makes the surplus for the quarter $163,376.65, as compared with $146,369.83, for the same period of 1902, an increase of $17,006.82.

Boston:	*Closing.*
American Telephone and Telegraph	126½
Edison Electric Illuminating	240
Massachusetts Electric	77½
New England Telephone	120
Western Telephone and Telegraph preferred	81

The Massachusetts Electric Companies has declared a regular semi-annual dividend of 2 per cent on the preferred stock.

The income account of the Boston Elevated Railway Company for the year ended September 30, just issued, shows that the gross earnings of the company for the year were $11,959,511, and the operating expenses $8,259,860, leaving a balance of $3,699,654. Other income amounted to $59,856, making the total net income $3,759,510. $3,730,556 was paid in charges and dividends, leaving a surplus of $28,954, as compared with $21,898 for 1902. The total assets of the company are $20,358,058, and the total liabilities $18,030,371, making the surplus $2,327,687, as compared with a surplus of $483,733 for the preceding year. For the year the number of passengers carried was 233,563,578, against 222,484,811 in 1902 and 213,107,600 in 1901.

Philadelphia:	*Closing.*
Electric Company of America	8
Electric Storage Battery common	50
Electric Storage Battery preferred	50
Philadelphia Electric	6⅛
Union Traction	44⅞
United Gas Improvement	81½

Chicago:	*Closing.*
Chicago Telephone	123
Chicago Edison Light	141
Metropolitan Elevated preferred	50
National Carbon common	20
National Carbon preferred	86
Union Traction common	5
Union Traction preferred	27

Chicago Telephone directors have declared the regular quarterly dividend of 2½ per cent, payable December 31. Books close December 24 and reopen January 2. The gain in the instrument output for November was 1,668, making the total now in use 99,570.

Lake Street Elevated reports for the year ending June 30, 1903, show a deficit of $49,170, against a surplus of $3,693 for 1902. The gross increase was $40,000, but operating expenses and charges increased $90,000.

The South Side Elevated for November carried a daily average of 143,398 passengers, an increase of 60,099. The gain is said to be due to the City Railway strike.

Metropolitan Elevated carried an average of 114,148 passengers in November, an increase of 3,859.

Northwestern Elevated carried a daily average in November of 71,422 passengers, an increase of 4,186.

AUTOMOBILE NOTE.

THE AUTOMOBILE CLUB OF AMERICA, 753 Fifth avenue, New York, announces the conditions governing entries in the United States for the Gordon Bennett Cup Race, which will be held in Germany in the summer of 1904, which are as follows: each entrant shall deposit with the club the sum of six hundred dollars. The racing committee of the club shall decide which of the entrants may compete in the race. This decision may be arrived at by a contest, or by the committee without a contest. Any entrant who is not nominated by the racing committee for the cup race shall have his entrance fee returned to him. Any entrant who after being nominated by the committee does not start shall forfeit his entrance fee. If three entrants are nominated to take part in the cup race, each entrant shall have two-thirds of his entrance fee (after deducting his proportion of the expenses incurred in holding the race) returned to him, provided he starts in the race. If two entrants are nominated, each of such entrants shall have one-half of his entrance fee (after deducting his proportion of the expenses incurred in holding the race) returned to him, provided he starts in the race. These rules are supplemental to the rules of the Gordon Bennett Cup Race, by which each entrant agrees to abide.

ELECTRIC RAILWAYS.

CEDAR FALLS, IOWA—Construction work on the Newton & Northwestern Railway is said to be progressing rapidly.

TONAWANDA, N. Y.—Engineers are making surveys for the tracks of the Niagara Transfer Railway Company. The new railroad is to be built along the Niagara river from Buffalo to Tonawanda.

BLOOMSBURG, PA.—The town council has granted the Danville & Bloomsburg Electric Railway entrance to the town. The new road will be ten miles in length, extending from Danville to Bloomsburg.

FALL RIVER, MASS.—A charter has been granted to the Horseneck Beach Street Railway Company with a capital of $200,000. The road is to run from Dartmouth to a point on the state line at or near Adamsville, R. I., a distance of nineteen miles.

CHAMBERSBURG, PA.—The People's bridge over the Susquehanna has been sold at last. The deal was closed for $210,000. The purchaser is the Central Pennsylvania Traction Company and the bridge will be used exclusively for trolley purposes.

MORGANTOWN, W. VA.—The Morgantown & Fairmont Traction Company has been reorganized. It is now known as the Morgantown & Pittsburg Railway Company, with a capital stock of $750,000. The incorporators are J. H. McDermott, Davis Elkins, T. R. Dille and C. R. Dille, of Morgantown, and C. W. Swisher, of Fairmont.

JERSEY CITY, N. J.—Papers have been filed at the county clerk's office in Jersey City by Frank Cook and R. W. G. Welling, of Manhattan, and Richard F. Tully, of Jersey City, incorporating the Interurban Traction Company, with a capital of $1,000,000, to operate electric and steam railways. Of the capital, $100,000 has been paid in.

BALTIMORE, MD.—The construction department of the United Railways Company has practically completed the extensive improvements begun about a month ago. More than fifteen miles of nine-inch girder rails were laid, and the system of lighting has been largely added to. It is estimated that about $500,000 was expended on the betterments.

ATHENS, GA.—The people of Gainesville have raised $10,000 for the electric line from Athens to Carnesville, and $20,000 more has been raised by the counties through which the line will extend. E. H. Van Wey and W. F. Brown, representing the new company, are in Gainesville, and the first work on the thirty-two-mile road will be commenced at once.

CHAMBERSBURG, PA.—Capitalists of the Cumberland Valley have subscribed funds sufficient to ensure the formation of a company which will build a trolley line from Harrisburg or Mechanicsburg through the valley to Hagerstown, connecting Harrisburg, Mechanicsburg, Carlisle, Shippensburg, Chambersburg, Greencastle, Waynesboro and Hagerstown.

NASHVILLE, TENN.—It is announced here that negotiations have been perfected for the requisite capital with which to build the Nashville & Lewisburg electric railway. It is estimated that it will cost $1,000,000. Chicago, New York and St. Louis capitalists have agreed, it is said, to put up the necessary money. Work on the railway is expected to begin next spring.

PHILADELPHIA, PA.—According to an official of the Philadelphia & West Chester Traction Company, the purpose of increasing the indebtedness from $400,000 to $1,000,000, which the stockholders will be asked to approve on January 11, 1904, is to refund the present $400,000 of five per cent bonds outstanding at four per cent, pay for construction work recently completed, and provide for future extensions and improvements.

CINCINNATI, OHIO—Peter Eichels is organizing a traction road with Charles E. Roth and several others as associates. Incorporation papers have been signed and mailed to the secretary of state, incorporating the Chester Park, Norwood & Red Bank Belt Line Traction Company, a $10,000 corporation proposing to build a traction railroad girding the city of Cincinnati, connecting the resorts at the end of the present city lines and all the outlying suburbs.

NASHVILLE, TENN.—Promoters of the McMinnville, Woodbury & Nashville Electric Railroad have decided to increase the capital stock from $10,000 to $1,000,000. Later on it is proposed to raise this to $2,500,000. It is said the contract for building the road has already been let to the Ellis Construction Company, of Chicago. One of the directors says the road will be extended into the coal fields beyond McMinnville some twenty miles. The road will have both freight and passengers.

GENEVA, N. Y.—It is announced that the Geneva, Waterloo, Seneca Falls & Cayuga Lake Traction Company, which operates a trolley line between this city and Cayuga lake, will next spring put on heavy vestibule interurban cars, similar to those with which the Rochester & Eastern is equipped. It is thought that this equipment is part of the plan to consolidate the three trolley companies which are now operating lines between Rochester and Syracuse along the line of the Auburn branch of the New York Central.

MEMPHIS, TENN.—The legislative council of this city has granted a franchise to the City Street Railway Company for the building and operation of an electric railway line in this city. The company has until the beginning of the year to accept or reject the franchise. St. Louis and local capitalists are interested in the project, Corwin H. Spencer and L. G. McNair, of St. Louis, being the largest stockholders. The present capitalization is $50,000, but this amount is to be increased to $500,000. Work must begin within six months.

WABASH, IND.—The following directors were elected at a meeting of the stockholders of the Wabash & Rochester Traction Company, in this city: P. E. Wilcox, Geneva, Ohio; C. E. Baney, Cleveland, Ohio; S. A. Holbrook, Bradford, Pa.; L. A. Smart, Cleveland; E. S. Pratt, Strattonburg, Pa.; Charles Crain, Geneva; G. S. Robertson, Geneva; Alva Taylor, Wabash; H. B. Shively, Wabash; S. E. Strong, Cleveland. There was a discussion of the project of building the road to Rochester from this city, and it was announced that work on the road would begin in the spring. All contracts for financing the road have been closed and a part of the construction material has been bought.

HAZLETON, PA.—The directors of the recently organized Hazleton, Weatherly & Mauch Chunk Traction Company have decided to begin work on the construction of the line as soon as the detailed surveys have been completed, which will be within two months. A Philadelphia syndicate, it is reported, will back the enterprise. Frank Larned, of Wilkesbarre, is president of the company. The road will be about twenty-four miles long, and will eventually connect with the trolleys running from Mauch Chunk to Tamaqua, and from Mauch Chunk to Lehighton, at which point connections are to be established with Allentown, making a continuous line from Philadelphia to Hazleton.

CHICAGO, ILL.—Articles of incorporation have been issued to the Blue Island, Riverdale & Hammond Street Railway Company, principal office Chicago, with a capital stock of $50,000. The line is to be constructed from Chicago south through Harvey, Phœnix, South Holland, towns of Calumet, Thornton, Chicago Heights and Steger, in Cook County, and Crete, in Will County, thence west to Joliet; and from Blue Island through Calumet, Riverdale and Dalton, thence northeast through Thornton, West Hammond; also a line from Tinley Park in an easterly direction through Homewood, Thornton and Lansing. The incorporators and first board of directors are William R. Owen, August W. Miller, John F. Noel, Henry Schanze and Michael J. Corcoran, all of Chicago.

WATERBURY, CT.—The Naugatuck Valley Electric Railway Company has perfected organization, with these directors: A. M. Young, of New York; Allen W. Paige, of Bridgeport; W. H. H. Wooster and Edmund Day, of Seymour, and A. D. Warner, of Beacon Falls. The directors have chosen Mr. Wooster president, Mr. Paige secretary, and Mr. Young treasurer. The corporation is to build a connecting link from Naugatuck through Beacon Falls to Seymour. At Naugatuck the line will connect with the Naugatuck division of the Connecticut Railway and Lighting Company's system and at Seymour with the Ansonia division of that company's system. The construction of the link will put Waterbury in direct trolley communication with New Haven and Bridgeport. The road, which will probably be constructed next summer, will be operated by the Railway and Lighting Company.

ELECTRIC LIGHTING.

MASONVILLE, IOWA—An electric light plant is to be installed here.

DETROIT, MICH.—Alden is to have a commercial electric lighting plant next spring.

GUTHRIE CENTER, IOWA—The electric light plant, that has been in course of erection for several months past, is now completed and the lights turned on. The plant cost $16,000.

WATKINS, N. Y.—The Consolidated Electric Light and Gas Company of this village changed hands the first of November and is now the property of Alfred L. Sweeney, of New York city.

MONTGOMERY, ALA.—The $15,000 bonds recently voted by Ozark to install an electric lighting plant for the city, have been sold by Mayor W. W. Kirkland to New York parties at par.

MALONE, N. Y.—The Fort Covington Light, Heat and Power Company has been incorporated with a capital of $12,000. The incorporators are Patrick Keefe, Nida M. Keefe and John C. Weeks.

PHILADELPHIA, PA.—Bids are invited for a power-house to be built at League Island. It will be one story high, 104 by 106 feet, and will be of brick and steel. Bids will be due December 26.

SPRINGFIELD, MASS.—The work of extending the electric light system from the Point to Broad Brook will be started as soon as possible, under the direction of the Windsor Locks Electric Light Company.

ELKHART, IND.—Superintendent Hewitt, of the power plant between Elkhart and Mishawaka, says it is the first of a chain of power plants to be erected on the St. Joseph river by eastern capital. The next plant is to be begun next spring just above Elkhart.

MILWAUKEE, WIS.—The International and the Phoenix light companies have consolidated under the name Phoenix-International Light Company, with a capital of $50,000, and elected Jacob Leenhouts, president; Theodore Roth, vice-president; A. M. Rodems, first vice-president; Joseph Sable, secretary; John Debbink, treasurer; Max Perwein, manager.

ALAMOGORDO, N. M.—Work has been begun on the electric light plant for Alamogordo. The concern is being promoted by H. Fisher, manager of the electric company already here, and several eastern capitalists are said to be interested. New lines will be built and the company will furnish power as well as light. The power-house will be thirty by sixty feet.

MOLINE, ILL.—A bill of $65 a light for 210 lights or more on a contract extending over a period of five years has been accepted by the city council from the People's Power Company. The bid was reported by the fire, water and light committee, and the committee was instructed to enter into contract with the company for that length of time dating from the expiration of the present contract next February.

GENEVA, N. Y.—The common council at its regular meeting let the contract for the street lighting of the city for the next five years to the Geneva Power and Light Company, at $75 per year for 107 arc lamps and $20 per year for forty-two incandescent lamps. According to the provisions of the new contract, the light company is to replace the old Brush lamps, now used in the city, with the latest improved enclosed arcs. It will also be obliged to light all of the city buildings free of charge and furnish the current for the operation of the city fire-alarm system.

JACKSON, MICH.—The Vincennes Electric Light and Power Company and the Citizens' Gas Light Company, both of Vincennes, Ind., have been purchased by Edward M. Dean & Company, and consolidated under the name of the Vincennes Light and Power Company, capitalized at $200,000. A first mortgage for $200,000 has been given and of the sum thus raised a quarter has been reserved for future extensions. The balance, amounting to $150,000, issued for the purchase and improvement of the property, has nearly all been subscribed in Indiana. The present capacity of the plants is to be doubled.

MENOMINEE, MICH.—One of the generators and dynamos of the new machinery for the power-house of the Menominee Light and Traction Company has been started and the other will be ready shortly. This new outfit cost the company $20,000 and nearly doubles the capacity of the plant. It includes two 5,000-light generators, a new marble switchboard, and other necessary apparatus. The machines supply power for lighting and street car locomotion. The capacity of the Menominee power plant will now be much greater than that of Marinette and some of the power will be transmitted to that city for lighting purposes.

ATLANTA, GA.—The Atlanta Water and Electric Power Company in the Superior Court of Fulton County filed a mortgage deed of trust to the Knickerbocker Trust Company, of New York, to ensure payment of its first mortgage. The first mortgage is to secure five per cent gold bonds, amounting to $1,500,000, due January 1, 1943, or on call after January 1, 1908. The security consists of land lots in Fulton County along the Chattahoochee river and lots in Cobb County along the Chattahoochee river. The security also includes all the buildings, machinery, and all other properties of the company. The security was dated October 1, 1903.

TOLEDO, OHIO—The council committee on gas and lights has approved the ordinance granting a franchise to the East Toledo Heating and Lighting Company with the amendments proposed by the subcommittee. The original franchise ordinance provided that the East Side company should pay two per cent of its gross proceeds to the city in exchange for its right to do business. The amendments demand that the company shall pay the city $10,000 cash before it begins construction, and that it shall heat and light all East Side school buildings, police and fire stations and other public buildings free of charge and that it shall also provide lights for the parks, free of cost to the city.

DAVENPORT, IOWA—The committee on fire and light recommends that the bid of the People's Power Company for lighting the city for a term of five years be accepted, and that the mayor and city clerk be instructed to enter into a contract with the company. This was the only bid offered and was at the rate of $65 per light for 240 or more lights. The specifications in the contract will also provide that all of the towers now giving light shall be taken down and the lights will be placed in the territory that they are now intended to illuminate. Under the contract now in force, which expires in February, the city pays $72 per light for the low lights and $82 for those on the towers.

FAIRMOUNT, IND.—After having been in darkness for the past four years the streets of this city will again be lighted. Several years ago the town bought an electric light plant, but after a few months it was closed down on account of poor management. Recently, the business men, seeing the need of street lights, took upon themselves the task of raising money to install a plant, and have succeeded in doing it. They sold stock for $50 a share, and each stockholder was given six small or one arc light free for one year. In all, more than $5,000 was raised. A committee has been appointed to put the plant in operation. It is the intention of the company to place about fifty arc lights in the town.

BALDWINSVILLE, N. Y.—At the regular meeting of the village board of trustees a lighting contract was entered into between the village and the Seneca River Power Company. The new contract is substantially as agreed upon several weeks ago. The lighting company is to furnish twenty-four arc lamps of 2,000 candle-power at $90 each and seventy-five incandescent lamps at $16 each, making the total cost of lighting under the new contract $3,360 per year as against $2,880 now paid for the ninety Nernst lamps used. The contract calls for the completion of the new system so that it will be in operation by April 1, and provides that the village may at any time meter the lamps to measure the current supplied and if it is found that the lamps are not up to the specified requirements a pro rata reduction is to be made on the lighting bills for the deficiency. The service is to be all night, the lamps burning from dusk to dawn. The village will have to be rewired for the new system.

INDUSTRIAL ITEMS.

THE ELECTRIC APPLIANCE COMPANY is advertising Zenith lamps for the Christmas trade and reports a big Chicago stock, so that prompt shipments may be made.

THE BROWN & SHARPE MANUFACTURING COMPANY, Providence, R. I., has published a fine catalogue showing its mechanical machinists' tools. This gives illustrations, descriptions, and prices of rules, squares, micrometer calipers, gauges and accurate test tools.

THE PITTSBURG SEWER PIPE AND CONDUIT COMPANY, Pittsburg, Kan., is getting out a new booklet illustrative of its various products. This includes chimney tops, chimney flue pipe, vitrified clay conduits, glazed wall coping, drain tile, fireproofing, sewer pipe and fittings, hollow brick, and partition tile.

THE WESCO SUPPLY COMPANY, St. Louis, Mo., is placing on the market a new dry cell, named the "Red Shield Dry Battery." This is adapted for all open-circuit work where a quickly recuperating cell is desired. The company states that this cell is the product of long study and is possessed of extremely long life. It has an electromotive force of 1.5 volts.

THE EWING-MERKLE ELECTRIC COMPANY, St. Louis, Mo., is sending out a large mailing card endorsed with the phrase-question, "Are You Up a Tree?" The company kindly offers to remove the obstacle in descending and suggests a remedy in its "Green Book." If this is not in the possession of any one requiring supplies, the company will mail it on application.

THE NEW CENTURY CORRESPONDENCE SCHOOLS, Wilkesbarre, Pa., have been organized to absorb and to increase the magnitude and scope of the American Correspondence Schools. The officers of the company are H. H. Zeiser, president; L. Floyd Hess, secretary, and W. S. Casterlin, treasurer. The school purposes to give a complete course of instruction in science and art, and will be pleased to send a prospectus to enquirers.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, Ohio, has ready for distribution bulletin No. 1019, descriptive and illustrative of "Alternating-Current Generators and Motors." This shows both water-wheel and belted types, as well as engine-type apparatus. A partial list of Bullock alternating-current installations shows how well this company is represented in every part of the world.

B. W. PAYNE & COMPANY, 39 Cortlandt street, New York city, announce that on November 30 the firm of B. W. Payne & Company was dissolved, and all outstanding accounts were taken over by Mr. Milton W. Curry, who also assumed the liabilities of the firm. In settlement of accounts, checks should be sent to Mr. Curry at the above address. The company further announces that business will hereafter be conducted at the same place by Mr. Benjamin W. Payne, under the old firm name.

MESSRS. DODGE & DAY, Nicetown, Pa., will be pleased to mail a copy of their pamphlet on "Betterment Reports" to station men and manufacturers looking to increasing their plant efficiency. Dodge & Day have made a thorough study of "modernizing" to the end of securing increased production, increased economy, and better facilities. The pamphlet has been prepared in the office of Ray D. Lillibridge, and, consequently, represents the best available in the printers and lithographers' powers.

THE MICA INSULATOR COMPANY, 218 Water street, New York, and 117 Lake street, Chicago, Ill., will send on request a new catalogue showing samples and giving specification of "Empire" insulating cloth. This is a linseed oil cloth of high insulating quality. The company has added to its line and changed the numbers of its old grades, so that in future its cloths will be known by the numbers in this new catalogue. The company also manufactures "Linotape." This is a tape coated with linseed oil and left with an adhesive surface.

THE BUFFALO FORGE COMPANY, Buffalo, N. Y., is distributing a couple of handsome catalogues descriptive of the Buffalo improved ventilators and the Buffalo disc wheels. These catalogues give a concise description of this apparatus, and a number of clear illustrations supply a good idea of the appearance and construction. These disc wheels are made for driving by either pulley, steam or electric power. The company has also issued a twelve-page pamphlet on "Heating and Ventilation of Factory Buildings," by W. H. Carrier, M. E. This is of great interest to consulting engineers engaged in this work.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., announces that Westinghouse gas engines are to be adopted in a new central station under erection at Berlin, Ontario. The initial installation will aggregate 460 horsepower, comprising three thirteen by fourteen three-cylinder 125-horse-power, and one eleven by twelve three-cylinder eighty-five-horse-power vertical engines. These engines will operate on city illuminating gas of 650 B. T. U. calorific value, and drive direct-current generators for furnishing municipal lighting. The publishing department of the company has just issued a new circular, No. 1,066, descriptive of type H induction motors.

THE CHARLES WARNER COMPANY, Wilmington, Del., sales agent for "Nazareth" Portland cement and "Sovereign" Portland cement, has published the results of some interesting tests on "Nazareth" cement and "Limoid." The use of "Limoid" is claimed to result in great economy to the contractor and builder, due to the spreading properties imparted by the hydrated lime. The mixture contains a large proportion of Portland cement, and the limoid in the mixture is hydrated with extreme care. It has the manufacturer's guarantee of non-pitting. The above tests were made by Booth, Garrett & Blair, and were of one part of the mixture and two parts of sand, to make direct comparison with standard Rosendale cement. The tests were made for seven days, twenty-eight days and three months, respectively, and show more favorably for the hydrated mixture. The company will be pleased to send this report in full on request from those who are interested in this work.

THE PACKARD ELECTRIC COMPANY, Warren, Ohio, will send to interested parties a booklet describing its gas engine cable. Instead of using a single wire for carrying current, forty strands of No. 30 tinned copper wire are used. This gives a more flexible connection, without danger of breaking, having at the same time a carrying capacity equal to a No. 14 solid conductor. Two layers of cotton thread are woven about the forty strands of conducting wire, and after each weaving the cable is passed through a bath of insulating liquid and baked in a steam-heated oven. Next in order come several layers of specially prepared tape, the number of thicknesses used depending upon the service for which the finished cable is designed. Each layer of tape receives two baths of insulating liquid and two bakings before being wound upon the cable, and one bath and one baking after being wound in place. The booklet mentioned gives a complete description of the process, and items concerning the ingredients of the insulating liquid. In addition to this, the booklet also contains interesting suggestions for automobile users.

THE ELECTRIC CONTRACT COMPANY, 202-204 Centre street, New York city, will be pleased to send its catalogue on dry batteries, electrical novelties and automobile specialties to any one requiring this list. This new catalogue illustrates the "Ecco" pocket lamps, "Evening Star" lamps, electric candles, night lights, illuminated watchstands, illuminated clock stands, electric scarf pins, electric gas lighters, medical sets, portable electric lanterns, surgeons and physicians' lamps, aseptic dental lamps, test sets, pocket battery outfits, dry cells and batteries, Williams spark coils—for which the company is the general selling agent—Jaeger bulbs, candelabra lamps, sockets and receptacles for candelabra and miniature screw bases, and "Handy" receptacles for Christmas tree and general decorative work. This receptacle is fitted with two triple insulated leading wires, and is provided with a sharp-pointed screw, thoroughly insulated by mica washers. This screw sticks easily into either hard or soft wood. The receptacle is furnished with either candelabra or miniature shells, and may be used for series or multiple work.